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POPULATION GROWTH IN SOUTHERN NEW ENGLAND, 1810–1860.

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The most striking, indeed the essential fact in the economic history of southern New England in the half-century before the Civil War was an increase in population. Where, in 1810, 800,000 persons had with difficulty been able to get a living, 50 years later there were 1,900,000 on a much higher standard of life.

TABLE I.

POPULATION OF SOUTHERN NEW ENGLAND, 1810–1860.

Year.	Massachusetts.	Rhode Island.	Connecticut.	Total.	Density per Square Mile.
1810	472,000	77,000	262,000	811,000	58.3
1820	523,000	83,000	275,000	881,000	63.5
1830	610,000	97,000	298,000	1,005,000	72.3
1840	738,000	109,000	310,000	1,157,000	83.2
1850	994,500	147,500	371,000	1,513,000	108.8
1860	1,231,000	175,000	460,000	1,866,000	134.2

An analysis of population growth by decades from 1790 to 1860 reveals a distinct division of the 70 years into three periods: (1) from 1790 to 1820, (2) from 1820 to 1840, and (3) from 1840 to 1860.

TABLE II.

RATE OF INCREASE OF POPULATION BY DECADES, 1790–1860.

Decade.	Per Cent. Increase.			
	Massachusetts.	Rhode Island.	Connecticut.	Southern New England.
1790–1800	11.6	0.0	5.5	12.8
1800–1810	11.5	11.4	4.4	9.3
1810–1820	10.9	7.8	5.0	8.7
1820–1830	16.7	17.0	8.2	15.2
1830–1840	20.9	12.0	4.1	14.0
1840–1850	34.8	35.6	19.6	30.8
1850–1860	23.8	18.4	42.1	23.3

The steady tide of emigration which had been draining the towns of southern New England since the Revolution, and in some cases since 1750, was not perceptibly checked until after 1820.*

At the year 1840 we find a sharp turning-point; before this date, taking the three states as one region, the increase had been slow and uniform, averaging about 14 per cent. in a decade. After 1840 the rate of increase was nearly twice as great. The contrast between 1830–1840 and 1840–1850 is particularly striking. Of the population of Massachusetts a contemporary writer said:

> The fifty years since 1790, seem to be naturally divided into two periods of about equal length; the first extending from 1790 to about 1820, and the second from 1820–1840. During the first, the soil being nearly all occupied for the purposes of agriculture, the surplus population emigrated out of the state, and settled in other states. During this period, the increase was small, and the number of towns incorporated was comparatively small also. During the second period from 1820 to 1840, though the number of new towns was even less increased, the number of inhabitants was increased in a much larger proportion, than in the first. The surplus population, instead of emigrating, were more retained at home by the encouragements held out by the increase of the manufacturing enterprise of the community. The first period was distinguished by greater emigration to other states, and by the pursuit of agriculture as the principal employment, and the second by the increase of manufactures.†

The vital question for the economic historian when confronted by facts such as these is "How was the increase in population supported?" The agricultural industry in southern New England at the beginning of the nineteenth century had shown itself incapable of supporting in their accustomed manner of life the natural increase of people. Continuous emigration to western states was the result. But within a half-century not only had emigration ceased, but over 375,000

* For a discussion of the extent and causes of this early emigration, see the writer's Rural Economy in New England at the Beginning of the Nineteenth Century, Transactions of the Connecticut Academy of Arts and Sciences, Vol. XX, pp. 383–391, New Haven, 1916.

† Chickering, Jesse, Statistical View of the Population of Massachusetts, 1765–1840, Boston, 1846, pp. 41–42.

persons of foreign birth had been received.* By what change in the manner in which New England people got their living, by what modification of their "mores of self-maintenance" were the additional 1,000,000 persons in these three states supported? To answer this question is the purpose of the present investigation.

The Concentration of Population, 1810–1860. In the first place it is evident from a closer examination of the population statistics, that something occurred to cause a concentration of people in urban communities. Their growth accounts largely for the entire increase. In 1810 there were over the whole area of southern New England only three towns containing more than 10,000 persons.† Their total population was 56,000, amounting to 6.9 per cent. of that of the three states. About one quarter of all the people lived in 49 towns varying in size from 3,000 to 10,000, and the great remainder, two thirds of the total, lived in townships of less than 3,000 population. In the last group most of the people lived in farm houses scattered over an area of 40 or 50 square miles; only a very few lived in the villages.

The corresponding figures for 1860 show a marked contrast. At the latter date 26 towns of over 10,000 contained in all 681,600 persons, or 36.5 per cent. of the total population. Of the remainder one third was to be found in the towns from 3,000 to 10,000 and about an equal number in the towns of smaller size.

Looking at these changes from another point of view, it appears that most of the increase in population is to be ascribed to the growth of 26 towns of the largest size. To the total increase of 1,055,000 these contributed 625,600 or 59 per cent. The towns between 3,000 and 10,000 furnished 38.9 per cent., and the smallest towns about 2 per cent. The total population of the last group was only 19,000 greater in 1860 than in 1810.

* The number given by the Eighth Census, 1860, was 378,204. The statistics of internal migration published in the same census showed that between 1850 and 1860 the movement of the free native white population from state to state had resulted in a net gain to Connecticut of 17,500 persons; to Rhode Island, 3,500 persons. Massachusetts had a net loss of 6,650, thus leaving a net gain to southern New England of 14,350 persons. These figures are found in the volume on Population, p. xxxiii.

† Boston, Providence, and New Haven.

TABLE III.

CONCENTRATION OF POPULATION IN URBAN COMMUNITIES.

Groups.	1810.	1840.	1860.
Total population	811,000	1,157,000	1,866,000
Total number of towns	437	479	526
Group I.			
Towns over 10,000	3	9	26
Population	56,000	214,090	681,600
Percentage of total	6.9	18.5	36.5
Group II.			
Towns 3,000–10,000	49	74	129
Population	210,300	340,200	620,700
Percentage of total	25.9	29.4	33.8
Group III.			
Towns under 3,000	385	396	371
Population	544,700	602,730	563,700
Percentage of total	67.1	52.1	30.1

It will be noted that the middle-size towns remained a curiously constant factor in the total population. The increase in the importance of the largest towns was accompanied by a continuous decrease in the importance of the smallest.*

The causes of urban concentration are in general familiar: manufactures, the maritime industries, commerce, domestic and foreign, fishing, and shipbuilding. In southern New England hundreds of small towns and villages grew rapidly in population in the first half of the 50 years as a result of the establishment of manufacturing enterprises of all sorts. The growth of a few cities of 15,000 or more in eastern Massachusetts, such as Lowell, Lawrence, and Fall River, in the years 1840–1860, was a more spectacular exhibition of the same forces. The influence of the extension of maritime enterprises, on the other hand, acted somewhat differently. The effects on population in this case were naturally confined to a narrow strip of seacoast and localized at the best harbors. In only a very few cases can any direct effect of commercial expansion in increasing population be found. It is safe to say that unless manufactures had developed there would have been a stationary condition if not a decrease in the population of most of the commercial towns.

The Maritime Industries in their Relation to the Growth of Population. In tracing briefly the history of the maritime

* Identical towns were, of course, not to be found in the same groups in 1810 and in 1860, except in rare instances. Many of the smallest towns grew into communities of considerable size, their places in the group being taken by the incorporation of new towns through the subdivision of some of the larger and older.

industries of the ports of southern New England in the years 1810–1860, we may distinguish a number of separate branches: (1) foreign trade, (2) the coasting trade, (3) the cod and mackerel fisheries, (4) whaling, (5) shipbuilding and the manufacture of cordage. At the beginning of the century, every coast town from Newburyport along the shores of Massachusetts Bay to Cape Cod, and from New Bedford and Providence along the Sound to New York, where there was any sort of harbor, owned and manned a few small fishing and coasting vessels. Many of these towns traded with the West Indies; some of them, such as Nantucket, New Bedford, and New London, had built up a thriving whaling industry and a few, such as Salem and Boston, sent out a number of large vessels each year which came back freighted with rich cargoes from Europe and the Far East.*

The Foreign Trade. The foreign trade of New England ports suffered a severe decline in the early decades of the nineteenth century. The Embargo and Non-Intercourse acts of 1807 and 1808 brought to a sudden stop the lucrative carrying trade which our ships had been performing for belligerent European nations. Hardly had these restrictions been removed when the War of 1812 came on, causing a further interruption of trade until the cessation of hostilities in 1815.†

With the notable exception of Boston, almost every port in southern New England suffered severely; in many the loss of ships and of men was so great that the ports never recovered their former position. Salem had, in 1805, 41,600 tons of shipping; in 1816 only 34,000. Out of 152 vessels engaged in foreign trade owned in this port only 57 remained in 1815.‡

* See Rural Economy in New England, Chapter II, for a fuller discussion of the extent and character of this commerce.

† The extent of commercial loss appears from the following statistics taken from Macgregor, John, The Progress of America, 2 vols., London, 1847, II, 144, 198, 205.

	Registered Tonnage.			
Year.	Massachusetts.	Rhode Island.	Connecticut.	Total.
1806	306,100	28,600	26,000	360,700
1816	274,000	24,200	24,600	322,800
		Exports.		
	Massachusetts.	Rhode Island.	Connecticut.	Total.
1806	$21,200,000	$2,091,800	$1,716,000	$25,007,800
1816	10,100,000	612,800	594,000	11,306,800

The most notable decline was of course in the amount of foreign produce exported.

‡ Osgood and Batchelder, Historical Sketch of Salem, Salem, 1879, p. 134.

The tonnage registered in Newburyport shrank from 31,650 to 24,700; in Fairfield, Connecticut, from 6,200 to 2,500; and in New Haven from 11,600 to 6,700. Boston was the only port showing any substantial increase (from 115,200 in 1805 to 143,400 in 1816), although fishing ports such as Plymouth and Marblehead made slight gains.*

After a short period of rapid recovery, 1816–1825, the foreign commerce of southern New England ports showed little growth until 1840. In the two succeeding decades, however, the statistics of exports and imports and of registered tonnage show remarkable increases. Massachusetts merchants and shipowners controlled most of the foreign trade in this period. Rhode Island and Connecticut ports lost foreign trade steadily from 1830 to 1850, the latter state showing sharp recovery, however, in 1850–1860.†

TABLE IV. (a)
(000 omitted.)

States	1840.			1860.		
	Imports.	Exports.	Tonnage.	Imports.	Exports.	Tonnage.
Massachusetts	$16,500	$10,200	178.9	$41,200	$17,000	472.0
Rhode Island	275	207	21.5	496	221	10.8
Connecticut	277	518	9.0	1,420	743	20.4
Total	$17,052	$10,925	209.4	$42,116	$17,964	503.2

(a) From U. S. Commerce and Navigation Reports. The tonnage figures are registered tonnage, not including whaling vessels.

A closer examination of the statistics of tonnage registered in the various ports of Massachusetts in the years 1830 and 1860 shows that Boston not only absorbed all the increase in foreign trade but even drew away much of this trade from the smaller ports. Thus in Massachusetts in 1830 the registered tonnage of all ports, exclusive of whaling vessels, was about 180,000. Of this amount Boston had 107,000 tons. In 1860 of the total of 472,000 tons, Boston had 411,400. The increase for the state was 292,000 and for the port of Boston, 304,000

* The figures for 1805 are from Morse, Jedidiah, The American Gazetteer, Boston, 1810; and for 1816 from Spofford, Jeremiah, Gazetteer of Massachusetts, Newburyport, 1828; and from Pease and Niles, Gazetteer of Connecticut and Rhode Island, Hartford, 1819.

† The increase of the coasting trade and of whaling contributed somewhat to the growth of population in the Sound ports, especially in New London, Stonington, and New Haven. In the last, as well as in Providence and Bridgeport, the manufacturing industries seem to have been more important than commerce.

tons. Salem and Plymouth suffered most from this transfer; in the former the loss was partly compensated by an increase in the coasting trade.

The Growth of Boston. It was this increase in commercial activity which was primarily responsible for population growth in Boston.

TABLE V.
INCREASE OF POPULATION IN BOSTON, 1810–1860. (a)

1810.	1820.	1830.	1840.	1850.	1860.
34,400	44,000	62,200	95,800	144,500	192,700

(a) Figures for the whole of Suffolk county, including the towns of Chelsea, North Chelsea, and Winthrop, as well as the city of Boston.

The period of most rapid increase in population, 1830–1850, was also that of most rapid commercial expansion. The tonnage of this port engaged in the coasting trade doubled in 1830–1840 and from 1840 to 1850 its foreign tonnage increased from 150,000 to 270,000. The first steam liner service between Boston and Liverpool was opened in 1840 and until 1848 Boston was the exclusive American port of destination. A few years later the famous Train Line of Liverpool packets was established. These two lines gave "an immediate and very remarkable impulse to the general trade of the city, and especially to its foreign business. . . . At no time have there been so many importing and jobbing houses in Boston as between the years 1840 and 1857, although a few houses now do a larger business than was done by all of them then. The coastwise shipping trade during this period was also very large. The supplies of cotton for the mills of New England came by sea; also the products of the Southwest, such as provisions, lard, lead, etc. In return we shipped to Southern ports domestic dry-goods, boots and shoes, furniture and wooden ware; and when everything else failed there was always a tonnage supply of ice and granite for every vessel seeking a cargo in that direction."*

The building of railroads in New England in the 20 years before the Civil War was largely responsible for the concentration of the commerce of the whole region in Boston. Many

* From an article by H. A. Hill in Winsor's Memorial History of Boston, 4 vols., Boston, 1881, Vol. IV, p. 228.

of the earliest roads had their termini in this city; others were soon connected with it. As early as 1845 we find Boston connected by rail with Lowell, Manchester, and with Nashua and Concord in New Hampshire; with Providence, Taunton, and New Bedford; with Marblehead, Salem, and Gloucester; with Portsmouth and Dover in New Hampshire; and with Portland, Maine; Springfield, Pittsfield, and Worcester, and with Albany and the Hudson River by the Western Railroad and the Boston and Worcester. At Worcester connection was made with the Norwich and Worcester road, built in 1840, and at Springfield with the road from New Haven, finished in 1844.*

In 1853 there were 39 lines of railroad completed in Massachusetts of a total length of 1,200 miles and 36 other lines under construction. A contemporary account reads: "By these roads Boston communicates directly with every important town in Massachusetts, and with most of those of the neighboring states. There are three lines of continuous railroads, uniting the capital of the state with New York and with the intermediate towns of Rhode Island, Connecticut, and central Massachusetts. Two other lines connect Boston with Portland and the towns between them. Two, one through Vermont, and the other through central New Hampshire, bring her into direct intercourse with Burlington, Vermont, and with Montreal, and with Ogdensburg; and another to Albany, opens an uninterrupted line of railway communication between Boston, Cincinnati, Terre Haute, and Chicago, and by the close of the present year (1853) will probably be united to St. Louis."†

Manufacturing enterprises in great variety, including iron manufactures of varibus sorts, machinery and steam-engines, stonecutting, leather dressing, painting, sugar-refining, and the manufacture of pianofortes had developed in Boston before 1860. According to the Massachusetts industrial census of 1855, these and other enterprises in Suffolk County employed 14,100 persons out of a total population of 172,000. Yet manufactures were relatively of less importance in Boston than in inland towns.‡

* See John Hayward's Gazetteer of Massachusetts, revised edition, Boston, 1849, pp. 422–434.

† From Lippincott, Grambo & Co.'s Gazetteer, Philadelphia, 1854, p. 676.

‡ This conclusion is based on a comparison of the proportions of the population engaged in manufacturing.

The New England Fisheries. New England fisheries flourished in the half-century before the Civil War, furnishing in their history the explanation of certain interesting population changes. At the beginning of the nineteenth century the cod and mackerel fisheries employed 1,200 vessels of 78,000 tons with crews of 10,360 men and boys, chiefly from the ports of Maine (then a district in the State of Massachusetts) and Massachusetts Bay.† In 1859 the number of vessels was 3,000, measuring 157,000 tons with crews of 22,700. The industry was still divided between Maine and Massachusetts in about equal proportions.‡

In Massachusetts up to about 1830 the principal fishing ports were Gloucester, Beverly, Boston, Marblehead, Newburyport, Plymouth, and the ports of Cape Cod. The history of the next 30 years shows the constantly increasing importance of Gloucester, while the other ports, with the exception of those on Cape Cod (Barnstable County), became comparatively insignificant competitors. The total fishing tonnage of the state was 61,700 in 1830 and 75,000 in 1860, the increase being 13,300 tons. In the same period the tonnage of Gloucester increased by almost 27,000.

TABLE VI.

TONNAGE ENGAGED IN COD AND MACKEREL FISHING.

Ports.	1830.	1840.	1850.	1860.
Newburyport	7,360	4,871	6,553	6,719
Ipswich	1,324	305	120	....
Gloucester	8,952	13,171	18,881	35,720
Salem	2,709	5,583	169	....
Beverly	....	....	....	4,601
Marblehead	5,362	4,617	2,936	5,821
Boston	5,428	7,788	6,239	1,704
Plymouth	8,047	7,380	6,631	4,536
New Bedford	1,210	149	494	264
Barnstable County	20,596	25,280	38,635	15,218

in various counties in Massachusetts in 1855. Whereas in Middlesex County 10 out of every 57 were so engaged, in Worcester, 10 out of every 46, and in Essex 10 in 30, in Suffolk County manufacturing employed only 10 in every 122 persons. The difference is only partially accounted for by the inclusion in the statistics of the inland counties of some household manufactures which of course would not have been carried on in Boston.

† The fisheries of Rhode Island and Connecticut, with the exception of the whaling industry, were never of importance. In 1807 all the fishing vessels of these states measured only 6,000 tons. In 1860 no fishing vessels were registered in Rhode Island ports; in Connecticut the tonnage was 6,700. Macfarland, Raymond, A History of the New England Fisheries, New York, 1911, p. 150, 153, 195–197.

‡ *Ibid.*, p. 174.

The influence of the fishing industry is clearly traceable in the growth of the population of Gloucester from less than 6,000 persons in 1810 to 14,141 in 1860.* Practically all of this increase must be ascribed to the extension of the maritime industry.† The history of the Gloucester fisheries shows great fluctuation in the several branches, but a steady progress as a whole. As soon as one branch proved unprofitable, another was developed, and when the fishing grounds in one region were exhausted, the enterprising skippers built larger vessels, extended their voyages and tried their luck in new waters.

From 1810 to 1820 there was little progress. After the interruption caused by the War of 1812, came a treaty more disastrous than the preceding hostilities, for by its terms the American fishermen were deprived of valuable treaty rights in Canadian and Newfoundland waters.‡ Moreover, the cod-fishing on the Grand Banks declined and consequently we find a small growth of population in this decade; 5,943 to 6,384. After 1820 shore cod-fishing§ became profitable and added to this was rapid growth in the mackerel catch. Scarcely had a decline become evident in this new branch when halibut began to be caught in great numbers on the Banks. When, just before 1840, the fisheries were seriously threatened by the departure of fish to more distant feeding grounds, the Gloucester men arose to the emergency, built larger vessels and extended their season. A few years later the off-shore cod-fishing revived.

In 1846 a railroad was completed connecting Gloucester with Boston. Cheaper and quicker transportation, together with the use of ice in packing fish for shipment, greatly extended the market for Gloucester fish and gave a new impetus to the industry. Just at the end of the 50's a new branch, the herring trade, was opened. In the early months of the year when the fishing fleet would otherwise be unemployed it began

* Including Rockport, originally a part of Gloucester but set off as a separate town in 1840.

† The only manufactures reported in the Massachusetts industrial census of 1855 were a cotton factory, employing 48 men and 135 women, and granite quarries employing 450 men. (Massachusetts, Secretary of State, Statistical Information Relating to Certain Branches of Industry, 1855.) The connection between fishing and granite quarrying is curious, the granite blocks originally taken out having been used as moorings for the fishing boats.

‡ Macfarland, New England Fisheries, pp. 154–155.

§ In 1832, 800 men were engaged in this branch alone. The Fisheries of Gloucester, 1623–1876, Gloucester, 1876, p. 30.

to make voyages to Newfoundland where large supplies of herring were purchased and transported to Boston to be sold partly for food and partly for bait.

The growth of population in Gloucester and Rockport was roughly parallel to the increase in the total tonnage of their fishing and coasting fleets, as appears from the following table:

TABLE VII.

POPULATION GROWTH AND TONNAGE STATISTICS, GLOUCESTER, 1810–1860.

Year	Population.	Tonnage.
1810	5,943	.....
1820	6,384	10,000
1830	7,510	12,600
1840	9,000	17,100
1850	11,060	22,500
1860	14,141	40,500

In 1855 over 80 per cent. of the entire male population between the ages of 15 and 60 were reported engaged in the fisheries.*

Barnstable County. This was always a unique region. Its infertile soil made an increase in agricultural population beset with even more difficulty than on the mainland. At the beginning of the century, a considerable portion of the food and fuel used by the inhabitants had to be imported from the mainland. Payment was made in the products of the fisheries and in the services of its coasting fleet. Without the development of any manufacturing enterprises,† the population of this county grew from 22,200 in 1810 to 36,000 in 1860. Here again an adequate explanation of population growth is to be found in the history of the maritime industries. The Cape Cod towns owned, in 1816, 16,000 tons of shipping, employed chiefly in cod-fishing. In 1851 the aggregate tonnage was 91,100, for the fishing fleet had more than doubled and, besides, a coasting fleet of almost 50,000 tons had been built up. The period of greatest increase in both these branches was 1830–1850; this was also the period of most rapid population

* This computation, including Rockport as a part of Gloucester, is based upon the Massachusetts Census of 1855. The proportion of males in the total population of Gloucester and Rockport was 51.6 per cent., which figure has been used in estimating the number of males in the above age-group.

† With the exception of a glass factory employing 500 persons and salt evaporation works employing 200 men. The latter industry had reached the height of its prosperity in the years 1835–1845.

growth.* After 1850 the aggregate tonnage fell off more than one third and population became practically stationary.

TABLE VIII.

BARNSTABLE COUNTY, POPULATION GROWTH AND TONNAGE STATISTICS, 1810–1860.

Year.	Population.	Total Tonnage.
1810	22,200	.....
1820	24,000	.....
1830	28,500	26,800
1840	32,500	56,600
1850	35,300	91,100
1860	36,600	63,600

Whaling Ports. The pursuit and capture of whales and the manufacture of whale oil and of spermaceti candles was a specialized branch of the fisheries. Larger ships, larger crews, longer voyages, and hence a much larger outlay of capital was necessary than in cod or in mackerel fishing. Consequently whaling, like all large-scale enterprises, tended to become concentrated at the best situations.† Nantucket, the leader until the War of 1812, lost half of its fleet of 46 vessels and its preëminence in that struggle.‡ Whaling, however, continued to be the principal occupation of the inhabitants of the island. In fact we find there the best example, with the possible exception of certain towns on Cape Cod, of a community dependent entirely on the maritime industries for its support. An official report in 1831 summarized the situation as follows: "The population of Nantucket is 7,225. For food, fuel, clothing and the material for building it depends on other places almost exclusively. Not a tree is fit for building; not a quarry; not a factory for cloth; not a piece of woodland, and but few cultivated acres, are to be found in an almost sterile island. Yet it is highly prosperous; but its resources are at an

*In 1850, the period of greatest prosperity for both the cod and the mackerel fleets, 8,865 men and boys, or considerably more than one representative from each family in the county, made up their crews. See Swift, Charles F., Cape Cod, An Historical Narrative, Yarmouth, 1897, pp. 315–316.

† There was also more distinct separation between owners and managers in whaling. The captain and the crew received wages, paid on a profit sharing plan, in part; the merchants and capitalists who owned and fitted out the ships remained on shore. The presence of a sort of leisure class in ports such as New London and New Bedford accounted for the cultivation there of the arts of life more than in other ports.

‡ Marvin, W. L., The American Merchant Marine, New York, 1902, p. 143 See also Morse, American Gazetteer, 1810.

immense distance in the Pacific ocean."* The climax of the prosperity of the island's unique industry came between the years 1840 and 1850; the decline which dates from this time was probably largely due to the increasing difficulty of fitting out vessels for long voyages at a port so far from the source of supplies. The lack of sufficient depth of water at its harbor entrance severely handicapped Nantucket in competition with New Bedford and New London.†

TABLE IX.

NANTUCKET, POPULATION AND TONNAGE OF WHALING FLEET, 1810–1860.

Year.	Population.	Tonnage.
1810	6,807	.....
1820	7,266	20,000
1830	7,202	19,817
1840	9,012	28,100
1850	8,452	19,050
1860	6,094	7,500

In 1860 the chief whaling port in New England, and in fact in the world, was New Bedford. From a fleet of 12 vessels which would not have averaged 250 tons each in 1805, this port had before the Civil War developed a whaling tonnage of nearly 130,000, employing 10,000 sailors. Whaling and the coasting trade, together with subsidiary industries explain almost entirely the increase in population in this port.

TABLE X.

NEW BEDFORD, POPULATION GROWTH AND TONNAGE STATISTICS, 1810–1860. (a)

Year.	Total Tonnage.	Whaling Tonnage.	Population.
1810	27,500	.....	5,651
1820	23,700	16,200	6,680
1830	51,400	25,900	10,626
1840	89,100	68,100	16,038
1850	131,400	96,400	20,747
1860	149,700	128,200	26,805

(a) The figures for 1810 and 1820, total tonnage, are for the nearest determinable date. For 1810 I have taken the statistics given by Morse in his American Gazetteer as of 1805 and for 1820 those given by Spofford, Gazetteer of Massachusetts, for 1818. The population figures for 1860 include the towns of Fairhaven and Acushnet, which were taken out of the original area of New Bedford.

* Documents Relative to the Manufactures in the United States. Executive Documents, 22 Cong., 1 Sess., Manufactures, Vol I, p. 202.

† Hunt's Merchants Magazine, XVII (1847), p. 377, mentions also a serious conflagration in 1846, destroying property valued at $1,000,000, which may have been a contributing cause.

Subsidiary industries such as the refining of oil and the manufacture of candles, the building of ships and equipping them with boats, masts, spars, sails, and cordage naturally grew up in such an important port.* Besides, cotton mills had been established in 1848 and enlarged in 1854, furnishing employment at that date for 500 persons.† It may be that the merchants and shipowners of New Bedford anticipated thus early the subsequent decline in the city's chief industry; at least it is true that among the names of the early financiers of the cotton manufacture are many which had long been associated with whaling.‡ The whaling industry as a whole had begun to decline just before 1860, due in part at least to overstocking the market with oil and bone. The rise in the price of these commodities had been continuous from 1830 until 1857, bringing steadily increasing profits to New Bedford capitalists. In the contemporary descriptions of the place we often find such statements as the following: "The whale fishery has proved very lucrative, and New Bedford is thought to be one of the richest cities in proportion to the number of its inhabitants any where to be found."§

The only other port of importance in whaling was New London. From very small beginnings, its fleet had increased to 77 vessels of 26,500 tons by 1845. Twenty-five of these ships in the next few years abandoned whaling for more lucrative trips to the California coast where gold had been discovered. Consequently the tonnage of the district in 1850 was only 11,500.‖ Some of the vessels returned to whaling, but the industry was never again important in New London. The growth of population which had been rapid in the years 1840–1850 (5,519 to 8,991) was considerably checked in the next decade (9,000 to 10,110). The decrease in whaling was to some extent offset by the establishment of a number of small manufacturing enterprises after 1852.¶

Shipbuilding and the Manufacture of Cordage. The shipbuilding industry reached the height of its prosperity in New

* Over 600 men were employed in these industries in 1855. Massachusetts Statistics of Industry, 1855.
† Crapo, William W., Historical Address, New Bedford, 1876, p. 51.
‡ Tower, Walter S., A History of the American Whale Fishery, Philadelphia, 1907, p. 75.
§ Hayward, John, Gazetteer of the United States, Boston, 1853, p. 471.
‖ Caulkins, Frances M., History of New London, 1612–1890, New London, 1895, pp. 644–645.
¶ See Adams, Sampson & Co.'s New England Business Directory, Boston, 1860.

England about 1850, when it furnished employment for 5,200 men in 366 shipyards. Between 1850 and 1860 the number of employees fell off almost one half and there was a corresponding decrease in the number of shipyards in operation. In 1860 the industry was almost equally divided between the states of Maine and Massachusetts, the latter having 89 shipyards with 1,400 employees. Medford, Newburyport, and Boston built practically all of the larger vessels in this state.* Only in the first of these towns can the influence of shipbuilding on population be clearly traced. Up to 1855, there was no other industry in Medford except shipbuilding and farming. Shipyards employing 160 men were established shortly before 1830 when the population of the town was only 1,755.† A small distillery employed three men, three hat shops employed 43 persons; the remainder of the population were farmers. In 1855 the shipyards employed over 1,000 men and the population had grown to 4,600. Practically no other industries had developed.‡

Accessory to shipbuilding was the manufacture of cordage. As early as 1810 Massachusetts was the leader in this industry in New England and in fact in the whole country. In 1860 practically all of the cordage of New England was made by 1,000 persons in 44 ropewalks in Massachusetts. The principal establishments were in Roxbury, Plymouth, and Boston, where their influence upon population growth was merged with that of manufactures in general, as well as with the other maritime industries.

Summary of the Influence of the Maritime Industries upon Population Growth. To summarize, it seems evident that in only a few coast towns was there considerably greater commercial or maritime activity in the years just before the Civil War than there had been in the years 1810–1830. Foreign trade had indeed increased, but its effects on population had been confined to the port of Boston. The fisheries had flourished with the extension of their market, but only the ports of Gloucester and of Cape Cod benefited thereby. The whaling

* Statistics of shipbuilding are found in the Censuses (U. S.) of 1850 and 1860 and in the U. S. Commerce and Navigation Reports for those years.

† Documents Relative to Manufactures, 1831, I, 346–347.

‡ A sash, door and blind factory employed 70 men. Massachusetts Statistics of Industry, 1855.

industry, too, was limited to New Bedford, Nantucket and New London. The coasting trade was the only branch of the maritime industries whose prosperity was widely dispersed. But even in this case, an increase in domestic commerce was often merely a compensation for the loss of foreign trade, and hence, as in the case of the ports on Narragansett Bay, an increase in population did not result from this cause. And finally, the increase in commercial activity of all sorts was to a large extent only the result of a more fundamental change, namely the growth of manufactures. A large part of the raw materials for the textile mills, the shoe and leather factories, the machine shops, and the metal manufactures came by water, either from other parts of this country or from abroad. Much of the food supply of the growing manufacturing towns, such as grain and flour, sugar and molasses, coffee, spices, etc., were transported by water to Boston and distributed thence by the railroads. That portion of the New England trade which was engaged in carrying the cotton of the southern states and some of the tropical products of the West Indies to Europe might have flourished had there been no industrial changes in the inland towns, but the entire increase in domestic commerce, and a considerable portion of foreign trade as well, was dependent upon the growth of manufactures.

The Rise of Manufactures and the Growth of an Industrial Population. England's industrial revolution of the last half of the eighteenth century was repeated in New England in the first half of the nineteenth. Economically the characteristic features were alike. On both sides of the Atlantic, the introduction of technical improvements, the increasing complexity of the division of labor, and the use of power-driven machinery brought about what is known as the factory system of production. The cost of transportation was lowered through the building of canals and railroads; with the market thus widened production was stimulated, old enterprises were enlarged, new factories established and the manufacturing population rapidly increased.

The social results following the establishment of the factory system of production in England were not as quickly apparent, nor in fact did they ever appear in such extreme form, in New

England. Our economic organization was much simpler in 1810 than that of the mother country had been in 1760. Most of our industrial products were turned out either in the farmhouses or in the shops of village artisans. Except in the shoemaking industry, the commission system had not been developed. Consequently there was in New England no industrial proletariat to be cruelly exploited. Hence we got our great industrial change without some of its more spectacular features.

Nevertheless, the growth of manufactures in southern New England in the years 1810–1860 was truly revolutionary. The establishment of mills and factories, on a small scale at first, in hundreds of small towns and villages and the subsequent growth of these enterprises were fundamentally responsible for a series of economic changes. It was the necessity for cheaper transportation facilities to bring raw materials to the factories, and to carry away their finished products, which led to the building of railroads connecting the industrial towns with the seacoast. It was the rise of an industrial population that must be fed which stimulated domestic commerce and gave a home market to the farmers. Until 1810 there had been practically no non-agricultural population in New England away from tide-water. Even the ten or twelve commercial towns contained but a small proportion of the total population. In these towns the nearest approach to manufacturing was found, but in them the industrial activities were mostly those of craftsmen, such as tanners and leather dressers, chandlers, coopers and cabinet-makers, shipcarpenters, etc. Such persons differed from the artisans of the country towns only in the fact that as their market was wider, so they were enabled to devote their entire time to a trade, thus becoming dependent on others for their food supplies. In the country towns, on the other hand, the artisans were regularly farmers as well, hence they cannot be classed as a non-agricultural, or food-consuming, element in the population. The beginnings of factory villages were to be found in only a few inland towns where such articles as tinware, clocks and shoes, for which a wide market existed, were produced by specialized workers.

The Causes of the Rise of Manufactures in New England. The causes of the rise of manufactures in the United States after 1810 are to be found in the circumstances which temporarily made it impossible to secure manufactured articles in any other way.* Before the interruption of foreign commerce in 1807, it had been the practice of the people in certain parts of the country to secure their manufactured articles from abroad. The tide-water plantations of the southern states were in the habit of exchanging their cotton, indigo, rice, and tobacco for the finer grades of clothing and house-furnishings. The Middle States and New England had no such great agricultural staples; for their grain, fodder and provisions there was no market except in the sugar plantations of the West Indies and in the rice plantations of South Carolina and Georgia.† The coast towns of New England were able to secure some foreign goods in exchange for the products of their fisheries and in payment for the services of their trading vessels in the carrying trade between Europe and the West Indies. For the farmers of the inland regions, both North and South, no such resources were available; whatever articles they found it impracticable to produce in the household, or in the shops of village artisans, they had to do without.

The interruption of commerce with Europe, in the years 1807–1816, suddenly cut off the supply of manufactures from abroad. The southern states could no longer export their staples; the northern skippers and fishermen found their industries paralyzed. It was this change in affairs which gave the embryo manufactures of New England their birth. The interruption of foreign commerce acted like a prohibitory protective tariff. It raised the prices of foreign-made goods to such a point as to make competition not only possible but extremely profitable. New England had the fundamental requisites for a manufacturing region. First of all it had an abundant supply of waterpower; it had also capital accumulated in commerce. When commerce was interrupted, this capital readily turned to investment in manufacturing.‡

* See Callender, G. S., Selections from the Economic History of the United States, Boston, 1909, Chapter IX, Introduction.

† See the author's Rural Economy in New England, pp. 294–304.

‡ A good example is to be found in the financing of the first cotton factories in Waltham and Lowell by

New England had the most concentrated as well as the most intelligent and energetic labor force to be found anywhere in the country. Its disadvantages, such as lack of technical knowledge and experience, the lack of improved machinery and the high cost of labor, were shared by other sections of the country which did not share the advantages.* The disadvantages, moreover, were but temporary in their nature; consequently the interruption of foreign commerce acted like a scientific application of protection to infant industries.

Early Stages in the Rise of Manufactures: 1810–1830. The new enterprises which sprang up with mushroom-like rapidity were but poorly equipped and were owned and managed for the most part by inexperienced men. Consequently the reappearance of foreign goods on the market after the War of 1812, in great abundance, at normal or less than normal prices, brought sudden disaster.† Many of the new enterprises were ruined, others suspended operations, and the whole upward movement in manufactures was checked. A period of readjustment followed, lasting until almost 1830. It was a time of elimination of the weakest concerns and of reorganization and rehabilitation of the stronger. After 1830 an era of real progress began, only temporarily interrupted by the crisis of 1837–1840, increasing steadily after 1840 and culminating in the brilliant decade, 1850–1860.

Progress in Manufactures, 1830–1860. In the years 1830–1860 there were two principal causes for progress in manufactures. In the first place there had been a great widening of the market through the increase of population in the newly settled regions across the Alleghenies, and through the increasing prosperity and purchasing power of the southern planters. The second general cause was the introduction of a number of important technical improvements, such as the power-loom in

Francis Cabot Lowell, Nathan Appleton and Patrick Tracy Jackson, merchants of Newburyport and Boston. See Cowley, Charles, History of Lowell, Revised edition, Boston, 1868, p. 37

* For a fuller discussion of these points, see Tudor, William, Letters on the Eastern States, New York, 1820, pp. 261–266.

† "Many of the manufacturers had rushed into the business, stimulated by the extraordinary rewards held out, with little or no knowledge of the methods and requirements of the manufacture, with insufficient capital, and with loose and unbusiness-like methods. All the circumstances warrant the belief that the contemporary records of the suffering and disaster which now befell them are not exaggerated." North, S. N. D., A Century of the American Wool Manufacture, in Bulletin of the National Association of Wool Manufacturers, XXIV, 234.

the textile industries, the Foudrinier machine in the paper industry, the use of sheet-brass in the manufacture of clocks, the Howe pin-making machine and sticking device, the use of the sewing machine in shoe-making and ready-made clothing industries, and the system of interchangeable parts in the manufacture of firearms, locomotives, steam-engines, and all sorts of machinery.*

Along with these improvements came a tendency toward production on a larger scale. Very few of the textile factories of 1830 employed as many as 100 hands; the great majority of them had less than 50.† A comparison of the figures given in the Censuses of 1840 and 1860 shows a decrease in the number of cotton mills in New England from 642 to 532 and an increase in the average number of employees from 60 to 122. Between the same dates the woolen mills decreased in number from 304 to 272 while the average number of employees in each increased from 28 to 82. The installation of new machinery and improved processes required the investment of more capital than many of the small concerns could command; hence they could not continue to compete with the newer and larger plants. When the market was still limited to the vicinity of each factory, advantages of situation were not decisive. But as the market widened those factories which were on a large waterpower, or whose managers could obtain a railroad connection, had such an advantage over their less fortunate or less foresighted competitors that they eventually absorbed most of the increase in business. After 1840 there is evident a distinct tendency for factories to concentrate in the towns which offered the best transportation facilities and in those in which a skilled labor force had collected, due to the long continued existence of a particular industry.‡

The Census of 1860 reported 20,700 manufacturing establishments in New England in which 392,000 persons were employed. Further analysis of the figures shows the bulk of

* The system of interchangeable parts, or the "uniformity system," was originated by Eli Whitney and first applied by him to the manufacture of firearms in New Haven, Conn., about 1800. An interesting description of the circumstances surrounding the development of the system is found in the Sketch of the Life of Eli Whitney, by William P. Blake, in the Papers of the New Haven Colony Historical Society, V, 116–126, New Haven, 1894.

† The statistics of manufactures collected in 1830 (Executive Documents, 22 Cong., 1 Sess.) show very clearly the small scale of manufacturing enterprises in New England towns.

‡ As, for instance, the britannia ware industry in Meriden, Conn.

manufacturing concentrated in the three southern states, Massachusetts, Rhode Island, and Connecticut. They had 12,400 establishments, employing 210,000 men and 103,000 women. The census officials were very liberal in their interpretation of the word "manufactures," including in the returns many occupations, such as basket-work, charcoal-burning, lumbering, blacksmithing, and the operation of saw-mills and grist-mills, all of which were in the rural communities but imperfectly separated from agriculture. In order to obtain a clear conception of the extent to which the growth of manufactures gave rise to a non-agricultural population, a strict interpretation of the word must be maintained, namely the business of producing goods for a wide market by the employment of specialized workers. Eliminating the pseudo-manufactures, we get the following figures showing the extent of manufacturing development in its principal branches in southern New England:

TABLE XI.

MANUFACTURES IN SOUTHERN NEW ENGLAND, 1860. (a)

Industries.	Number of Establishments.	Employees.
Cotton	530	65,200
Woolen	270	21,000
Other textiles	92	6,890
Boots and shoes	1,600	66,000
Ready-made clothing	390	14,300
Hats and caps	92	2,720
Paper	154	4,550
Printing and bookbinding	231	3,310
Iron; mining, casting, rolling, etc.	200	6,660
Brass and copper	178	5,700
Hardware and cutlery	384	13,100
Agricultural implements	129	2,000
Machinery	324	9,680
India rubber	16	1,200
Musical instruments	52	1,100
Cigars	105	1,250
Jewelry	148	3,200

(a) Taken from the Eighth (U. S.) Census, Manufactures.

Effects of Rise of Manufactures on Population Growth. The connection between the rise of manufactures and the growth of population may be shown first by a comparison of the population statistics in the various counties in southern New England between the years 1810–1860. All of the counties started on a fairly even basis as regards manufactures in 1810. By 1860 some counties had industries whose importance, as measured by the value of their annual product and by

the number of persons employed, was many times that of others. The manufacturing counties showed invariably the greater increase in population. In Connecticut, for instance, New Haven County had in 1860 manufacturing enterprises whose annual product was valued at $23,400,000, employing 18,800 persons; its population had increased 163 per cent. since 1810; in Litchfield County on the other hand, the annual value of the manufactures in 1860 was only $5,700,000; 4,500 persons were employed, and the increase in population in the half-century had been only 12 per cent. In Rhode Island a similar contrast is afforded by Providence and Washington counties. In the former the value of manufactures in 1860 was $29,200,000 and the number of employees 22,700; in the latter, manufactures were worth only $4,000,000, employing 2,700. The increase in population in Providence County had been 281 per cent. and in Washington County only 23 per cent. Massachusetts counties afford similar comparisons.

More valuable conclusions are obtained by limiting the scope of the inquiry to the smallest units of population, the towns. Taking first the group of 26 towns which in 1860 had a population of over 10,000 each, we find 12 containing 258,000 people, whose growth depended entirely on manufacturing; Worcester, Springfield, Lawrence, Lowell, Lynn, Taunton in Massachusetts; Providence, North Providence, and Smithfield in Rhode Island; Waterbury, Norwich, and Hartford in Connecticut.* In these towns 64,600 persons, or 25 per cent. of the population, were engaged in manufactures. A second division of the group is made up of 11 towns; Boston and its suburbs, Charlestown, Cambridge, Chelsea and Roxbury; Newburyport, Salem, and Fall River, all in Massachusetts; New London, Bridgeport and New Haven, in Connecticut. In all of these except Boston, the growth of population in the years 1840–1860 had been due almost entirely to the growth of manufactures; from 1810 to 1840, maritime industries had been more important. Of the 380,000 people in the 11 towns, 45,000, or 12 per cent., were engaged in manufacturing. Finally we find three towns, New Bedford and Gloucester, in Massachusetts, and Newport, Rhode Island, whose growth was due almost entirely to the prosperity of some branch of

*Providence, Norwich, and Hartford had before 1810 depended largely on commerce for their prosperity.

the maritime industries. Their population amounted to 43,700 in 1860 of which only 2,360, or 5.4 per cent., were in factories. Among the 23 towns whose growth was due, entirely or in large part, to the development of manufactures, many had already gained prominence in a particular line; thus Lowell, Lawrence, and Fall River and the Rhode Island towns were leaders in textiles, Providence in jewelry as well, Lynn in boots and shoes, Waterbury in the brass industry, New Haven in the manufacture of carriages and clocks, and Norwich in paper and textiles.*

The growth of Lowell is a striking illustration of the effect of manufacturing upon population. In 1820 there were on the present site of the city three villages, containing in all some 250 persons. The waterpower resources of the place had as yet attracted only a woolen mill and a few grist and saw mills. In 1822 the Merrimac Company secured control of the waterpower and began the building of a number of large cotton mills. Between that date and 1830, five large cotton manufacturing companies built mills at Lowell, as the place was now called, after Francis Cabot Lowell, one of the pioneers in its development. The population enumerated in the Census of 1830 was 6,474, of whom more than one half were factory operatives. The parallel growth of the number of factory employees and of total population is shown by the following table:†

TABLE XII.

POPULATION AND MANUFACTURING IN LOWELL, 1837–1860.

Year.	Total Population.	Factory Operatives.
1837	18,000	8,560
1845	25,160	9,235
1855	37,554	14,661
1860	36,827	13,206

* Statistics of the number of persons employed in manufactures in cities of 10,000 inhabitants and over are given in a letter from the Secretary of the Interior, Executive Document No. 29, 39 Cong., 1 Sess. (1866). The above conclusions are also based upon material found in the New England Business Directory (1860), in city directories and local histories, in Massachusetts Statistics of Industry, 1855; Statistics of Certain Branches of Industry in Connecticut, 1845; and Report upon the Census of Rhode Island, 1865.

† The facts in this paragraph are taken largely from Charles Cowley's History of Lowell. The population figures in Table XII for 1837 and 1845 are from Hayward's Gazetteer of Massachusetts (revised edition, 1849, p. 187); for 1855 from the Massachusetts State Census of that date, and for 1860 from the Eighth U. S. Census. The statistics of factory operatives for 1837, 1845 and 1855 are from the industrial statistics compiled in Massachusetts in those years and for 1860 from the Letter of the Secretary of the Interior, 39 Cong., 1 Sess., Executive Document No. 29, 1866.

Of the smaller towns in Group I (over 10,000), Waterbury, Connecticut, is a typical example. In 1820, when the brass industry first became permanently established there, the population of the town was 2,882, having been practically stationary since 1790. In 1860 the population was 10,004. The industrial growth of the town is outlined by a local historian as follows: "It was the metal button business that led to brass making, the industry upon which the town has chiefly been built up. . . . By 1840, the business of manufacturing sheet metal had taken the lead of all the others. Then began the fostering and development of other branches of business, the demands of which would consume this product. Pins, hooks and eyes, tubing, brass kettles, clocks, spoons and forks—the thousands of articles which can be made of sheet metal and wire, were added to the list of manufactures, as well as the incidental industries of machine making, acid making, casting, forging, and supplying the other things used and consumed in the various processes of the main production."* In 1845, the factory operatives numbered 727;† and in 1857, 2,730 were employed in five brass and copper mills and in 17 various sorts of subsidiary industries.‡

Out of the 129 towns in Group II (5,000 to 10,000), we may select for closer study the 47 whose population had grown to exceed 5,000 by 1860. Of these only three, Barnstable, Nantucket, and Brookline, all in Massachusetts, had failed to develop manufacturing enterprises supporting a considerable proportion of their inhabitants. Typical towns in this division were Danbury and Meriden in Connecticut. In the former the expansion of the manufacture of felt hats explains an increase of population from 3,600 to almost 9,000 (1810–1860); in this business more than one seventh of the inhabitants were employed at the latter date.§ Meriden had early been the seat of the tin-ware industry to which, in the years 1830–1860, the manufacture of britannia ware, silver-plated

* Anderson, Joseph, D.D., The Town and City of Waterbury, Ct., 3 vols., New Haven, 1896, II, 262-263.

† Statistics of Industry in Connecticut, 1845.

‡ Bronson, Henry, M.D., History of Waterbury, Waterbury, 1858, pp. 561-563.

§ Francis, W. H., History of the Hatting Trade in Danbury, Conn., Danbury, 1860, gives a valuable account of the origin and growth of this town's chief industry.

ware, ivory combs, cutlery, buttons, small iron articles, etc., was added. The population increase was from 1,250 to 7,500 in the half-century.* Among the towns showing most rapid growth were a few in eastern Massachusetts in which shoemaking employed a large proportion of the inhabitants.† Thus Randolph, in which over 1,500 persons were making shoes in 1855, showed a gain of 400 per cent. in population, 1,170 to 5,760; in Natick, 1,570 persons out of a total of 5,490 made shoes, the population growth from 1810 to 1860 being 610 per cent. Shoemaking was also largely responsible for the growth of Marlboro (1,675 to 5,900) and Woburn (1,220 to 6,290). The growth of 19 manufacturing towns, of this group, in Massachusetts was 312 per cent.; four towns in which maritime industries were more important, Barnstable, Beverly, Marblehead, and Plymouth, showed a growth of less than 40 per cent.

The dependence of population growth upon manufacturing can be shown also by taking certain typical counties and examining the history of each town separately. Thus it invariably appears that whatever increase in population took place in the county can be accounted for, at least in large part, by the growth of its manufacturing towns. In New Haven County, Connecticut, we find an increase in population of 60,300 in the half-century, of which more than one half, 32,300, is accounted for by the growth of the city of the same name. About 17,000 more was contributed by the growth of three manufacturing towns, Meriden, Waterbury, and Derby. Thus 49,100 out of the total increase of 60,300 is accounted for. The remaining 11,200 was distributed among a number of smaller towns, in practically all of which some manufacturing was carried on. In Windham County in the same state, the increase in the years 1810–1860 was 12,380, of which 11,000 can be accounted for by the growth of seven textile towns.‡

* In 1850, out of the total population of 3,560, about 600 were employed in the above-mentioned manufactures. See Davis, Charles H. S., History of Wallingford, including Meriden and Cheshire. Meriden, 1870, pp. 494–495.

† Shoemaking in these towns was not yet a factory industry; some of the processes, such as cutting the leather, were done in central shops, but the bulk of the work of sewing the uppers and attaching the soles was done by the country folk, men, women and children, either in their own homes or in small shops near their houses. See Hazard, Blanche E., The Boot and Shoe Industry in Massachusetts, in Quarterly Journal of Economics, XXVII, 236–262.

‡ Thompson, Killingly, Plainfield, Windham, Pomfret, Putnam, Scotland.

Applying the same method to several counties in Massachusetts, we get similar results. Thus in Plymouth County the gain in five decades was 29,600; to this increase five manufacturing towns contributed 23,500.* In Berkshire County the total increase was 19,300, of which 17,800 was supplied by the growth of six towns with flourishing manufactures.† In Bristol County, commerce as well as manufactures appears as a cause of growth. The growth of five towns accounts for 50,200 out of the total increase in population of 56,600.‡

Population Changes in Agricultural Towns. The foregoing pages have shown that wherever in southern New England, in the 50 years before 1860, there was an increase of population, the explanation may be found either in the expansion of maritime industries or in the establishment of manufacturing enterprises. But the converse of this statement is also true; wherever there was neither commerce nor fisheries nor factories, there, population was either stationary or declining. So widely were the small manufacturing businesses distributed before 1860 that in some counties such as Essex, in Massachusetts, and Windham, in Connecticut, not a single purely agricultural town could be found.§ In hilly inland counties, such as Franklin and Berkshire, in Massachusetts, on the other hand, the agricultural towns made up a considerable proportion of the entire number. A careful study of the occupations of the inhabitants of all the towns in southern New England reveals 112 in which agriculture was the sole industry; of these 68 were in Massachusetts, 38 in Connecticut, and 6 in Rhode Island. The movement of population in a typical group of Massachusetts towns (Franklin County) is shown in table XIII.

The declining tendency exhibited by this small group of agricultural towns, especially after 1830, is also shown by the entire group of 112 towns taken together.‖

* Abington, Bridgewater, Wareham, Hingham, and Plymouth.

† Adams, Great Barrington, Lee, Pittsfield, Stockbridge, and Williamstown.

‡ Attleborough, Easton, Fall River, Taunton, and New Bedford; the last being the only town in which the maritime industries were of great importance. For the growth of population in New Bedford see Table X, p. 825.

§ I have defined as "purely agricultural" towns with no manufactures for a wide market employing as many as 25 persons. The sources used in the selection of these towns were the industrial censuses of Massachusetts and Connecticut already cited, the gazetteers and local histories.

‖ The decline in the population of the purely agricultural towns does not necessarily indicate a decline

TABLE XIII.

POPULATION OF 14 AGRICULTURAL TOWNS IN FRANKLIN COUNTY, MASSACHUSETTS, 1810–1860.

	1810.	1820.	1830.	1840.	1850.	1860.
Ashfield	1,809	1,748	1,732	1,610	1,394	1,302
Bernardston	811	912	918	992	937	968
Charlemont	987	1,081	1,065	1,127	1,173	1,075
Gill	762	800	864	798	754	683
Colrain	2,016	1,961	1,877	1,971	1,785	1,798
Hawley	1,031	1,089	1,037	977	881	671
Heath	917	1,122	1,199	895	803	661
Leyden	1,009	974	796	632	716	606
Monroe	....	....	265	282	254	236
Rowe	839	851	716	703	659	619
Shutesbury	939	1,029	986	987	912	798
Sunderland	551	597	666	719	792	839
Warwick	1,227	1,256	1,150	1,071	1,021	932
Wendell	983	958	874	875	920	704
Total	13,881	14,378	14,145	13,639	13,001	11,883

TABLE XIV.

POPULATION OF 112 AGRICULTURAL TOWNS, 1810–1860.

	Massachusetts 68 Towns.	Connecticut 38 Towns.	Rhode Island 6 Towns.	Total 112 Towns.
1810	68,104	51,863	9,076	129,043
1820	70,910	51,207	9,618	131,735
1830	69,453	51,261	9,047	129,761
1840	67,771	48,601	7,463	123,835
1850	67,693	49,763	7,210	124,666
1860	65,577	50,229	7,373	123,179

in the total agricultural population, nor does it imply a decrease in the productivity of the agricultural industry in southern New England in the 50 years. It is possible that in many of the smaller manufacturing towns, such as those in Group II (3,000–10,000), the agricultural element may have increased in numbers. As for the productivity of agriculture, the natural supposition would be that, because of the stimulation of the home market, the farmers must have found larger production profitable. This increased production might have taken place, as it did in the North Central States after the Civil War, along with a decided decrease in the rural population. (See Hibbard, B. H., The Decline of the Rural Population, in QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION, New Series, No. 97, Vol. XIII, March 1912.)

WHOLESALE PRICES IN THE UNITED STATES, 1791–1801.

By Harold V. Roelse.

The aim of this work was to gain some definite idea of the trend of the price level following the adoption of the federal constitution. Mr. Alvin H. Hansen worked out indices of wholesale prices for the years 1801 to 1840, inclusive, in 1915,* and the original plan of the present work was to carry the study back to 1789.

To make the results comparable, Mr. Hansen's system was followed in general. The first step in the procedure was the attempt to secure monthly statements of wholesale prices of a considerable number of commodities. Yearly averages of these prices were then computed, and, using the year 1791 as a base, indices were computed for each commodity. A simple arithmetic average of the indices of all commodities was computed for each year, and these yearly index numbers were adjusted to the base 1860 to make them comparable with Mr. Hansen's curve.

The primary difficulty encountered was the scarcity of material. The only quotations of wholesale prices available for this work were those appearing in the Philadelphia *General Advertiser*, 1791–1793, inclusive, and in the Philadelphia *Gazette* and *Universal Daily Advertiser*, 1795–1801. No figures were found for the years prior to 1791, nor for the years 1794, 1796, and 1800. Reports were not available for twelve months of any year. The number of monthly reports and the number of commodities for which prices were secured appear in Table I.

In Table II are listed the commodities used and the yearly averages of the monthly quotations—in the order in which they appear in the *General Advertiser*. Some adjustments were necessary before these averages could be computed, such as adjusting changes in measures or quantities quoted. It was also necessary to change about half of the original figures

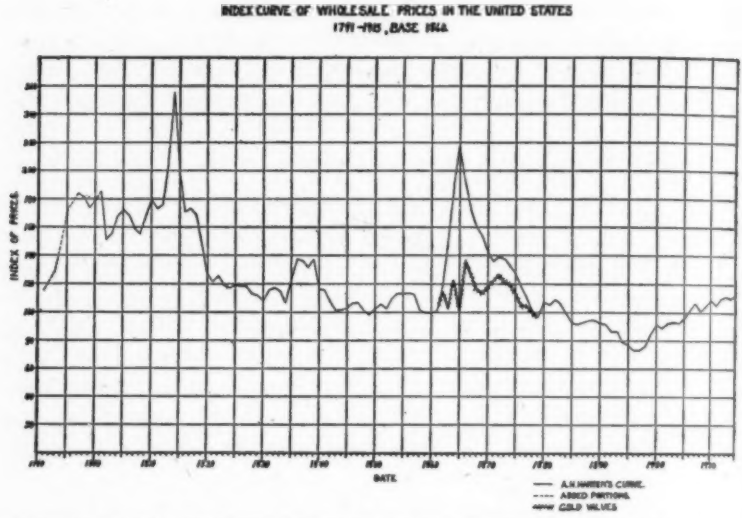
*Quarterly Publications of the American Statistical Association, December, 1915.

from the English monetary system to the present American system. The ratio used in this adjustment was seven and a half shillings to the dollar, which it appears was the ratio maintained in Pennsylvania during the period under consideration.

Table III represents the relative prices of these commodities for each year, index numbers having been computed using the year 1791 as the base. The average yearly index for all commodities appears at the end of the table and is taken to represent the relative level of prices for the period.

In order to join these figures to the curve plotted by Mr. Hansen it was necessary to find the ratio between them and his index numbers, adjusted to the base 1860 to make them comparable to the index numbers given in the Aldrich report. This was done in the following manner. First an index number was computed for Boston for the year 1801, as shown in the last columns of Tables II and III. Only one report could be secured for Philadelphia in that year—October thirty-first—so the Boston report was taken for about the same date. It will be seen that the average indices for the two cities are almost identical. While some prices were higher in Boston, others were correspondingly lower than in Philadelphia. The ratio of the Philadelphia index number for 1801 to Mr. Hansen's final index number for the same year was found to be 1 to 1.159. The average indices for the period 1791–1801 are therefore multiplied by 1.159.

Table IV contains the indices for the entire period 1791–1915, adjusted to the base 1860. Mr. Hansen's final indices are not tabulated so they had to be worked out from the original indices before the curve accompanying this work could be plotted accurately. His original indices were multiplied by 1.188 as he suggests. The index numbers of the U. S. Bureau of Statistics of Labor, base 1890–1899, were used for the period 1890–1913 in Mr. Hansen's work, and the present writer was able to add the indices subsequently published for 1914 and 1915. In adjusting these indices to the base 1860 they were multiplied by 1.098, as the Bureau of Labor reports for 1890 and 1891 are 1/1.098 of the indices for the same years in the Aldrich report.



INDEX CURVE OF WHOLESALE PRICES IN THE UNITED STATES 1791–1915, BASE 1860

The curve of wholesale prices represents the indices in Table IV graphically presented, and also the gold prices during the period of currency inflation from 1861 to 1879.

The existence of some inaccuracies in this work must be admitted. In the part of the curve that is original some slight errors were probably made in collecting the data. Toward the end of this period (1801), several varieties of some commodities, such as coffee, were quoted, while the earlier lists of prices contained very little in the way of specifications as to varieties or qualities of such commodities. An effort was made, however, to keep the same grade of each commodity throughout the work. Usually a high grade was chosen, but in the case of some commodities such as Madeira wine, a low grade was found to be quoted more steadily. The lack of complete data of course constitutes the chief weakness of this work. No high degree of accuracy is claimed for this portion of the curve, but it is believed that it represents approximately the course of prices for the period.

Where no material was available for a particular year, in plotting the curve it was necessary to connect directly the

points plotted for the preceding and following years. Referring to the curve, however, it will be noticed that in no case is more than one year at a time not definitely plotted, and that it is improbable that the price level actually deviated so widely for such years as to seriously affect the trend of prices during the decade. To be specific, in 1792 and 1793 the price level is evidently going upward quite rapidly; 1794 is missing, but in 1795 prices were very much higher and it is probable that in 1794 the prices were at least somewhat higher than in 1793; 1796 is missing, but following it are three consecutive years of high prices, so it is not probable that the price level was very low that year—it seems quite possible that it may have been even higher than the curve would indicate. As for the last missing year, 1800, a few reports for Charleston, South Carolina, show that prices were lower in that year than in 1801. The same was probably true in Philadelphia.

In conclusion it may be said that while this work can not be considered a highly accurate representation of the relative level of prices for specific years, it would seem to indicate conclusively that the decade following 1790 was a period of rapidly rising prices in the United States.

TABLE I.

Years.	Number of Monthly Reports.	Number of Commodities.
1791	11	68
1792	11	66
1793	8	68
1794	None	..
1795	10	58
1796	None	..
1797	5	59
1798	10	62
1799	3	56
1800	None	..
1801	1	56

TABLE II.

YEARLY AVERAGES OF WHOLESALE PRICES IN PHILADELPHIA (a), 1791–1801 (b).

Commodities.	Years.								
	1791.	1792.	1793.	1795.	1797.	1798.	1799.	1801.	1801. (Boston)
Ashes, pot—ton	$102.30	$100.00	$115.00	$141.33	$120.00	$124.80	....	$120.00	$140.00
Bread, ship-Pilot—cwt.	4.02	3.49	3.50	8.47	8.75	7.15	$8.50	....	8.00
Boards, Oak per M.	13.90	11.95	16.00	17.33	17.40	12.00	20.00	17.50	17.50
Boards, Merch. Pine—M.	15.23	19.30	23.00	25.33	25.33	24.00	26.00	13.00	14.25
Boards, Cedar—M.	14.19	16.73	18.00	20.00	20.00	24.00	26.00	....	....
Beef, Boston—bbl.	7.25	8.00	9.00	13.40	16.00	13.50	12.00	16.00	16.00
Beef, Country—bbl.	6.59	7.00	7.75	12.96	14.75	12.50	9.33	14.50	13.00
Butter—lb.	.149	.16	.16	.164	.15	.16	.16	.16	.20
Chocolate—lb.	.130	.176	.20	.26	.27	.25	.25	.25	.20
Coal—bu.	.215	.22	.225	.307	.375	.33	.303	.33	....
Coffee—lb.	.193	.19	.18	.224	.27	.25	.30	.23	.22
Cotton—lb.	.255	.378	.395	.31	.40	.40	.427	.40	.44
Copperas—cwt.	2.08	1.67	1.67	....	....	....	....	3.00	3.00
Cordage	8.28	8.00	8.25	....	....	....	....	16.00	16.00
Flour, superfine—bbl.	5.13	5.05	5.80	10.87	9.31	8.00	9.50	....	10.00
Flaxseed—hhd.	5.60	7.13	7.68	6.75	17.00	12.40	....	....	6.56
Glue—lb.	.155	.184	.20	.204	.17	.20	.18	....	.33
Gin, Holland—gal.	.767	.794	.885	1.27	1.50	.90	.97	1.30	1.12
Wheat—bu.	1.02	.944	1.16	1.93	....	1.34	1.70	1.67	....
Rye—bu.	.58	.512	.58	.955	....	1.00	....	1.00	1.00
Oats—bu.	.29	.278	.356	.41	.40	.40	....	.50	.55
Indian Corn—bu.	.41	.456	.547	.655	.73	.508	.49	.80	.53
Barley—bu.	.59	.888	1.02	1.09	1.27	1.33	....	1.00	1.12
Hams—lb.	.08	.09	.11	.122	1.45	.134	.11	.17	....
Lard—lb.	.09	.09	.10	....	....	....	....	.19	.19
Honey—gal.	.60	.60	.60	.90	.90	1.27	1.33	....	....
Hemp—ton	146.93	146.67	146.67	194.67	266.67	270.00	260.00	280.00	270.00
Hoops, hogshead—M.	15.67	15.00	15.00	30.00	29.33	29.00	29.00	16.00	20.00
Hides, raw—lb.	.11	.11	.11	.11	.103	.094	.10	....	....
Iron Bar—ton	80.50	83.06	86.25	85.60	114.50	98.33	98.33	130.00	120.00
Iron, Pig—ton	28.35	26.67	25.33	28.67	34.67	36.00	40.00	35.00	35.00
Iron, Sheet—ton	172.30	173.33	173.33	220.00	214.67	216.53	200.00	250.00	....
Herring—bbl.	2.75	2.85	3.00	....	6.00	5.60	3.83	7.50	4.25
Lead, Bar—cwt.	6.65	7.00	7.00	....	....	....	....	8.00	8.00
Leather, "soal"—lb.	.183	....	.20	.222	.20	.20	.20	.22	.21
Meal, Indian—bbl.	2.73	2.54	2.60	3.77	4.50	3.10	2.71	....	4.75
Mackerel—bbl.	8.27	8.82	8.00	11.58	12.75	12.00	9.00	11.00	9.50
Molasses—gal.	.37	.492	.51	.59	.70	.628	.647	.50	.49
Nails—lb.	.094	.10	.10	.122	.128	.13	.13	.12	....
Oil, Linseed—gal.	.50	.606	.654	.644	1. 9	.70	.657	.85	.92
Oil, Whale—gal.	.267	.267	.24	.40	.46	.47	.28	.61	.60
Oil, Olive—gal.	.86	.87	.87	....	....	....	....	1.87	....
Pitch—bbl.	2.32	2.00	2.00	3.01	4.67	3.50	3.00	5.00	5.00
Pork, Burlington—bbl.	11.67	11.09	12.94	16.33	18.75	18.20	15.00	26.00	26.00
Pork, Lower County—bbl.	10.45	10.91	11.56	15.07	16.00	15.50	14.00	24.00	23.00
Peas, Albany—bu.	1.09	.73	.73	1.00	1.13	1.00	.83	....	....
Pepper—lb.	.49	.432	.38	.40	.323	.298	.327	.20	.28
Pimento—lb.	.182	.17	.185	.16	.15	.17	.16	.16	.20
Rice—cwt.	2.88	2.71	3.11	5.15	3.58	2.73	2.33	6.00	6.25
Raisins—box	4.33	3.60	2.63	4.10	4.38	4.05	4.00	4.00	3.75
Rum, Jamaica—gal.	.83	1.135	1.12	1.16	1.60	1.40	1.22	1.40	1.20
Saltpetre—cwt.	12.00	13.75	14.33	....	....	42.50	50.00	30.00	30.00
Shot—ton	132.60	140.00	140.00	160.00	147.50	200.00	200.00	180.00	180.00
Ste l, German—cwt.	9.29	9.18	9.00	9.20	10.92	11.00	14.33	....	....
Steel, American—ton.	126.27	113.21	113.33	133.33	127.33	156.00	156.00	81.00	....
Soap, Castile	.104	.11	.11	.28	.18	.20	....	.16	.16
Russia Sheeting	12.00	12.27	15.00	....	....	....	....	....	16.00
Sugar, Hav., white—cwt.	13.30	17.50	17.50	....	19.00	18.60	19.33	17.00	16.00
Sugar, Hav., brown—cwt.	10.00	15.00	11.75	13.33	16.50	13.60	14.67	13.00	12.50
Salt, Liverpool	.30	.306	.384	.70	.52	.68	.79	.58	.58
Shingles, Long—M.	10.23	13.90	13.00	20.00	20.00	18.00	18.00	....	....
Scantling, heart—M.	15.17	23.33	23.33	....	....	46.00	36.00	17.75	....
Staves, W. O. Hhd.—M.	19.25	19.42	20.33	37.87	44.25	35.00	35.67	16.00	30.00
Tar—32 gal. bbl.	1.66	1.50	1.50	3.20	3.33	3.25	2.20	4.00	4.50
Turpentine	2.50	2.00	2.165	3.21	4.00	3.50	2.50	3.00	5.00
Tobacco, James River	4.59	3.84	4.09	6.07	8.50	11.10	10.00	7.00	5.50
Tea, Hyson	1.12	....	1.28	2.00	1.70	1.44	1.53	1.13	1.10
Wine, Madeira—pipe	106.67	131.46	176.00	168.00	227.33	200.00	200.00	240.00	240.00

(a The last column gives comparative prices for Boston.
(b) No figures were available for 1794, 1796, or 1800.

TABLE III.

INDEX NUMBERS OF YEARLY AVERAGES OF WHOLESALE PRICES IN PHILADELPHIA (a) 1791–1801, BASE 1791 (100).

Commodities.	Years.							
	1792.	1793.	1795.	1797.	1798.	1799.	1801.	1801. (Boston)
Ashes, pot—ton	97.75	112.41	138.16	117.30	122.00	....	117.30	136.85
Bread, ship-Pilot—cwt.	86.82	87.08	210.80	217.65	177.88	211.46	....	199.00
Boards, Oak per M.	85.98	115.11	12 .67	125.18	86.33	143.88	125.90	125.90
Boards, Merch. Pine—M.	126.73	151.03	166.32	166.32	157.60	170.72	85.36	93.58
Boards, Cedar—M.	117.90	126.87	140.96	140.96	169.14	183.25	....	....
Beef, Boston—bbl.	110.35	124.14	184.84	220.70	186.23	164.53	220.70	220.70
Beef, Country—bbl.	106.22	117.60	196.70	223.85	189.70	141.57	220.05	197.30
Butter—lb.	107.40	107.40	110.07	100.07	107. 0	107.40	107.40	134.22
Chocolate—lb.	135.38	153.85	200.00	207.70	192.31	192.31	192.31	153.85
Coal—bu.	102.33	104.66	142.80	174.42	154.88	140.95	154.88	....
Coffee—lb.	98.44	93.26	116.08	139.90	129.54	155.45	119.17	114.00
Cotton—lb.	148.22	154.90	121.60	156.85	156.85	167.45	156.85	172.55
Copperas—cwt.	80.30	80.30	....	....	....	....	144.23	144.23
Cordage	96.60	99.65	....	....	....	....	193.25	193.25
Flour, superfine—bbl.	98.42	113.05	211.90	181.50	155.95	185.20	....	194.93
Flaxseed—hhd.	127.32	137.13	120.54	303.55	221.42	....	....	117.15
Glue—lb.	118.72	129.04	131.62	109.70	129.04	116.14	....	212.90
Gin, Holland—gal.	103.54	115.40	165.60	195.60	117.35	126.50	169.50	140.04
Wheat—bu.	92.56	113.75	189.23	....	131.40	166.70	163.74	....
Rye—bu.	88.28	100.00	164.66	....	172.44	....	172.44	172.44
Oats—bu.	95.87	122.78	141.40	137.95	137.95	....	172.42	189.68
Indian Corn—bu.	111.22	133.42	159.78	178.05	123.90	119.53	195.12	202.45
Barley—bu.	150.50	172.88	184.75	215.25	225.42	....	169.50	189.85
Hams—lb.	112.51	137.52	152.53	181.30	167.53	137.52	212.54	....
Lard—lb.	100.00	111.12	....	....	....	....	211.14	211.14
Honey—gal.	100.00	100.00	150.00	150.00	211.70	221.70	....	....
Hemp—ton.	99.83	99.83	132.50	181.50	183.76	176.97	190.56	183.76
Hoops, hogshead—M.	95.74	95.74	191.46	187.18	185.07	185.07	102.10	127.64
Hide , raw—lb.	100.00	100.00	100.00	93.65	85.46	90.92	....	....
Iron, Bar—ton	103.18	107.14	106.33	142.25	122.15	122.15	161.50	149.07
Iron, Pig—ton	94.08	89.35	101.13	122.30	127.00	141.10	123.45	123.45
Iron, Sheet—ton	100.61	100.61	127.70	124.60	125.68	116.08	145.11	....
Herring—bbl.	103.63	109.10	....	218.18	203.72	139.26	272.73	154.54
Lead, Bar—cwt.	105.26	105.26	....	....	....	....	120.30	120.30
Leather, "seal"—lb.	....	109.30	121.32	109.30	109.30	109.30	121.32	114.75
Meal, Indian—bbl.	93.04	95.24	138.10	164.84	113.56	99.26	....	174.00
Mackerel—bbl.	106.65	96.74	140.03	154.18	145.10	108.84	134.22	114.88
Molasses—gal.	133.00	137.85	159.48	189.20	169.74	174.88	135.15	132.45
Nails—lb.	106.37	106.37	129.78	136.15	138.28	138.28	127.64	....
Oil, Linseed—gal.	121.20	130.80	128.80	218.00	140.00	131.40	170.00	184.00
Oil, Whale—gal.	100.00	89.88	149.82	172.30	176.05	104.90	228.50	224.73
Oil, Olive—gal.	101.17	101.17	....	....	....	....	207.44	....
Pitch—bbl.	86.20	86.20	129.74	201.30	150.86	129.32	215.52	215.53
Pork, Burlington—bbl.	95.02	110.90	139.94	160.62	155.97	128.54	222.82	222.82
Pork, Lower County—bbl.	104.40	110.63	144.22	153.12	148.33	134.00	229.68	220.10
Peas, Albany—bu.	66.98	66.98	91.75	103.67	91.75	76.16	....	....
Pepper—lb.	88.16	77.50	81.63	65.92	60.82	66.74	59.18	57.14
Pimento—lb.	93.41	101.65	87.91	82.41	93.41	87.91	87.91	109.88
Rice—cwt.	94.10	108.00	178.82	124.30	94.79	80.90	208.35	217.02
Raisins—box	83.14	60.74	94.69	101.15	93.53	92.37	92.37	86.60
Rum, Jamaica—gal.	136.75	134.95	139.76	192.78	168.70	147.00	168.70	144.58
Saltpetre—cwt.	114.60	119.42	....	....	354.20	416.70	250.00	250.00
Shot—ton	105.60	105.60	120.66	111.23	150.83	150.83	135.75	135.75
Steel, German—cwt.	98.80	96.87	99.91	117.53	118.40	154.23	....	....
Steel, American—ton	89.65	89.75	89.75	100.85	123.55	123.55	64.15	....
Soap, Castile	106.73	106.73	269.23	173.10	192.31	....	153.85	153.85
Russia Sheeting	102.26	125.00	....	....	....	....	....	133.33
Sugar, Hav., white—cwt.	131.58	131.58	....	142.86	139.85	145.33	127.82	120.30
Sugar, Hav., brown	150.00	117.50	133.30	165.00	136.00	146.70	130.00	125.00
Salt, Liverpool	102.00	128.00	233.33	173.30	226.67	263.30	193.33	193.33
Shingles, long—M.	127.07	127.07	195.50	195.50	175.95	175.95	....	....
Scantling, heart—M.	153.80	153.80	....	....	303.25	237.30	117.00	....
Staves, W. O. Hhd.—M.	100.90	105.67	196.72	229.88	181.82	185.30	83.11	155.85
Tar—32 gal. bbl.	90.36	90.36	192.77	200.60	195.78	132.53	240.98	271.10
Turpentine	80.00	86.60	128.40	160.00	140.00	100.00	120.00	200.00
Tobacco, James River	83.66	89.11	132.24	185.20	239.64	217.87	152.50	119.82
Tea, Hyson	....	114.30	178.51	151.80	128.57	136.61	100.90	98.20
Wine, Madeira—pipe	123.23	165.00	157.50	213.11	187.48	187.48	225.00	225.00
Average	105.62	111.74	147.72	158.69	156.47	150.12	159.33	159.54

(a) Last column gives comparative figures for Boston.

TABLE IV.

INDEX NUMBERS OF WHOLESALE PRICES IN THE UNITED STATES, 1791-1915, BASE YEAR 1860.

Date.	Index.	Date.	Index.	Date.	Index.	Date.	Index.	Date.	Index.
1791	115.9	1816	170.6	1841	115.8	1866	191.0	1891	92.2
1792	122.4	1817	172.7	1842	107.8	1867	172.2	1892	86.8
1793	129.5	1818	168.1	1843	101.5	1868	160.5	1893	86.8
1794	....	1819	148.1	1844	101.9	1869	153.5	1894	79.1
1795	171.2	1820	127.0	1845	102.8	1870	142.3	1895	76.9
1796	....	1821	121.5	1846	106.4	1871	136.0	1896	73.6
1797	183.9	1822	125.1	1847	106.5	1872	138.8	1897	73.6
1798	181.4	1823	118.9	1848	101.4	1873	137.5	1898	75.8
1799	174.0	1824	117.5	1849	98.7	1874	133.0	1899	83.5
1800	....	1825	118.8	1850	102.3	1875	127.6	1900	91.2
1801	184.7	1826	118.1	1851	105.9	1876	118.2	1901	89.0
1802	151.7	1827	118.3	1852	102.7	1877	110.9	1902	92.3
1803	155.9	1828	113.1	1853	109.1	1878	101.3	1903	93.4
1804	167.0	1829	111.8	1854	112.9	1879	96.6	1904	92.3
1805	172.1	1830	108.6	1855	113.1	1880	106.9	1905	95.6
1806	168.2	1831	114.9	1856	113.2	1881	105.7	1906	101.1
1807	159.6	1832	116.6	1857	112.5	1882	108.7	1907	106.6
1808	155.6	1833	115.0	1858	101.8	1883	106.0	1908	101.1
1809	....	1834	107.1	1859	100.2	1884	99.4	1909	104.4
1810	178.7	1835	123.3	1860	100.0	1885	93.0	1910	108.8
1811	173.1	1836	137.5	1861	100.6	1886	91.9	1911	105.5
1812	175.9	1837	136.3	1862	117.8	1887	92.6	1912	109.8
1813	204.8	1838	130.9	1863	148.6	1888	94.2	1913	111.0
1814	255.2	1839	136.9	1864	190.5	1889	94.2	1914	109.8
1815	200.4	1840	116.8	1865	216.8	1890	92.2	1915	112.0

THE CORRELATION OF HISTORICAL ECONOMIC VARIABLES AND THE MISUSE OF COEFFICIENTS IN THIS CONNECTION.

By Willford I. King.

He who reads statistical literature nowadays finds it literally teeming with studies in correlation. Apparently, the time has arrived when a statistician's ability is largely judged by his output of correlation coefficients. Unfortunately, however, many of the coefficients seem to be more valuable as mementoes of industry than for any new truth which they add to human knowledge. In fact, it may be said without exaggeration that only too often the statistician has been so entranced by the mathematical possibilities of the problem that he has lost sight of the real meaning of the operations involved and hence the conclusions presented have been utterly fallacious and entirely contrary to the facts. Is it not time to call a halt and ascertain just what ends may and may not be served by this newly popular mathematical aid?

It is apparently in the correlation of historical variables that statisticians have wandered astray most frequently. Economists have borrowed a new machine from mathematicians and have proceeded to use it without understanding its workings. As a result, strange and wonderful laws of economics have been deduced; figures have been made to lie most glibly, and all because the limitations of the device have not been recognized. Perhaps a brief explanation of correlation and its meaning may prove helpful to others who, like the present writer, may have searched long in the literature on the subject and found little enlightenment.

The first question is "What does the term correlation mean?" Evidently, it implies some relationship between things, and this particular relationship is always one of cause and effect. If a change in A causes a change in B, there is said to be correlation between them. Likewise if a variation in A causes both B and C to vary, there is said to be correlation between B and C. But, if B and C should, for entirely unconnected reasons, happen to vary in the same manner, there would be

no correlation between B and C, since the relationship is not a causal one.

One of the laws of physics is that a given force always produces identically the same effect whenever it is applied. Does this same rule hold good for economic or social phenomena? There is every reason to believe that it is exactly as valid here as in the other parts of the physical world. If this is not true, it is useless to hope for any material advancement of economic science. A law which only works part of the time is no law at all. Economics deals with physical beings and forces and it would be strange indeed if it should prove an exception to the general rules of the natural world. The chemist knows that 16 grams of oxygen and 2 grams of hydrogen will make exactly 18 grams of water. The physicist is certain that a force of one dyne will always give an acceleration of exactly one centimeter per second to one gram. They allow for no exceptions to the rule. The economist, on the other hand, has usually been satisfied to say that a lessening of the wheat supply by one tenth will increase the price, to an indefinite extent, perhaps 20 per cent., or perhaps 40 per cent. The natural scientist figures accurately; the economist ordinarily calculates but vaguely. Why is this true? The fact seems to be that the "natural" sciences are more highly developed and better understood than the science of economics. They are older and mathematics earlier lent them its aid. Economists are now really just beginning to utilize mathematics and their attempts in this line are still marked by the crudeness of the amateur.

One of the chief reasons why economists have put so little faith in the mathematical accuracy of the laws which they have formulated is that many of them have not fully comprehended the principle of the resultant of several forces acting simultaneously. They have failed utterly to appreciate or to utilize the concepts which are to the physicist the most elementary bases of the study of mechanics. They have attempted to deal with whole groups of variable forces at once instead of separating them carefully and studying the effects of each individual force by itself.

Isaac Newton long ago pointed out the fact that when several physical forces act on a body at the same time each

produces its own effect regardless of the others and that any motion arising is the resultant of all the independent forces compounded. Thus gravity, the bore of the gun, and the explosive force of the powder all act together in determining the movements of the projectile. The physicist has long ago separated these component forces and he can point out accurately the part played by each. Economists, on the other hand, are only beginning to realize that they must attack a problem in a manner identical with that used by the physicists.

To illustrate: If a steamboat which, in still water, would travel ten miles an hour proceeds upstream in a river flowing four miles per hour, the net result is but six miles an hour of actual progress. No physicist would think of attempting to measure the propulsive force of the engines by the distance traveled without first allowing for the effect of the river current. Economists have, however, habitually been guilty of making exactly this error. For example, they have attempted to correlate the cyclical movements of two variables, recording changes in business, without first removing the long time trends due perhaps to currency changes or population growth. They have tried to study the cycles of industry without recognizing the fact that they were dealing with a complex of distinct oscillations of different wave lengths and amplitudes rather than with one simple sine curve. They have asserted that, since the money curve does not correspond with the price curve, prices evidently do not vary exactly and proportionately with the money supply. All of these are clear instances of a failure to recognize the imperative necessity of excluding all forces but the one to be studied, before making any comparisons.

Another illustration may make this necessity more evident:

The change in wheat prices in 1916 was due to several independent forces, among which were:

1. Currency inflation.
2. The sinking of wheat in the Atlantic Ocean.
3. The commercial isolation of Russia.
4. Shortage of agricultural labor in Western Europe.
5. Poor climatic conditions for wheat.
6. Increased consumption in soldiers' rations.

A graph of the figures would show that wheat prices did not vary in the same proportion as the money supply. Neither did they vary inversely in the same ratio as the yield per acre. A study of the stocks of wheat on hand each month would show that the price did not conform to the theoretical supply and price curve worked out for this grain. The superficial critics would say that here was first class evidence of the inexactness of so-called economic laws. Yet it was doubtless true that each of the forces governing the price of wheat played its part with the same mathematical exactitude with which the hydrogen and oxygen united to form water. The price of wheat was a resultant of all the forces acting in unison. Why have economists been so slow to recognize the principle here illustrated?

One part of the explanation seems to be that it has been more difficult to separate for measurement the economic than the chemical or physical forces. In the economic field, it has not been feasible to control the conditions of the experiment. Because of this fact, it has been necessary to call upon the science of statistics to differentiate the effects of these separate forces. This new science has responded nobly, but, as yet, it has failed to accomplish the desired end with the precision attained by the chemist or physicist by experimental methods. Fortunately, however, this phase of the science is advancing so rapidly that the outlook for the future appears most encouraging.

If the assumptions just made are correct, if economic and physical phenomena are governed by laws equally exact, there can be no such thing as imperfect or partial correlation. Every correlation to exist must be perfect. Every cause must produce its effect exactly and invariably. If the cause and its effect are once completely isolated, the coefficient must always be unity. In every case, there either is or is not correlation between variable A and variable B—there can be no middle ground.

But it is common to obtain correlation coefficients of 0.3 or 0.6 or 0.7. What do these decimals mean? They merely indicate that the cause and its effect have not been completely isolated—that the effects of conflicting forces still enter in to

mar the results. The low coefficients, then, in no sense indicate imperfections in the actual correlation, but they do show conclusively that the statistician has failed in his efforts to exclude some of the untoward forces which ought to have been eliminated. This failure may have resulted from a non-comprehension of the complexity of the forces involved; from a lack of sufficient information to render the elimination of undesirable forces feasible; or from ignorance of the proper statistical methods which must necessarily be utilized in the process. Those troubled by errors arising from the cause last mentioned would be helped by reading the admirable articles in the June, 1917, issue of THE QUARTERLY PUBLICATIONS OF THE AMERICAN STATISTICAL ASSOCIATION, by Professors Irving Fisher and Warren M. Persons, in which they discuss the merits of some of the various methods of eliminating the effects of the forces which must be excluded before correlating the particular cause and effect under consideration.

The wave motions which are so universal in natural phenomena are just as common in economic fields. These waves have different lengths and amplitudes and the analysis of a compound of several such waves is no simple task.* The economist will do well to study carefully the methods used in analyzing light and sound waves and the general characteristics of sine curves before attempting the simplification of the data at hand. He is almost sure to find that his problem is strikingly similar to those with which the physicists have grappled so successfully. Once the undesired forces have been completely eliminated, and the resulting figures have been plotted, two curves emerge—one representing the cause and the other the effect. If the elimination has been entirely successful, the fluctuations in the curves will correspond perfectly and the correlation will be evident at a glance. To compute a coefficient to prove whether correlation does or does not exist is, in this case, a manifest waste of energy.

In attempting by graphic methods, therefore, the correlation of two supposedly related historical variables, two curves are derived which either do or do not resemble each other closely. If they are very similar, all the correlation coefficients in the world will add nothing to the knowledge gained simply

by observing the curves. If they are dissimilar, it may be impossible to say whether there is or is not correlation. In this case, it is easy to tell in advance that a coefficient, if computed, will be low and will, therefore, prove nothing conclusively. In either instance, therefore, the coefficient has added nothing whatever to the knowledge obtainable from the graphic presentation. Too frequently, the coefficients presented are worse than useless for they lend the glamor of apparent erudition to a carelessly made study. Do coefficients, then, have any place in the correlation of historical variables?

So far as the present writer has been able to observe they have but one valid use. The size of the coefficient is merely a means of determining the closeness of fit of two curves. If there is a lag, that is if there is a time interval between cause and effect, it is frequently difficult to determine by the eye the exact lag which has actually occurred. In this case, by trying coefficients with lags of different lengths, it is possible to ascertain the approximate time interval which gives the best fit to the curves—in other words, the most common lapse of time required for the cause to produce the effect. Aside from this purpose, the labor of computing coefficients for historical economic variables seems to be largely wasted. When coefficients are used to cover up careless work in failing to eliminate the causes not under consideration, their use becomes inexcusable.

Strangely enough, many writers still seem to confuse correlation coefficients with the ratio of variation. It is entirely unnecessary for the ratio of variation to approach unity in order to give a high coefficient as the following simple examples will show.

RATIO OF VARIATION UNITY.

Size of Item.	Deviation from Arithmetic Average. x	Deviation Squared. x^2	Size of Item.	Deviation from Arithmetic Average. y	Deviation Squared. y^2	xy
32	−2	4	64	−4	16	+8
33	−1	1	66	−2	4	+2
34	0	0	68	0	0	0
35	+1	1	70	+2	4	+2
36	+2	4	72	+4	16	+8
		10			40	20

$$r_1 = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{20}{\sqrt{10 \times 40}} = \frac{20}{20} = 1.$$

RATIO OF VARIATION 0.5.

Size of Item.	Deviation from Arithmetic Average. x	Deviation Squared. x^2	Size of Item.	Deviation from Arithmetic Average. y	Deviation Squared. y^2	xy
32	−2	4	66	−2	4	+4
33	−1	1	67	−1	1	+1
34	0	0	68	0	0	0
35	+1	1	69	+1	1	+1
36	+2	4	70	+2	4	+4
		10			10	10

$$r_1 = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{10}{\sqrt{10 \times 10}} = \frac{10}{10} = 1.$$

In both instances the coefficients computed by Karl Pearson's method show perfect correlation, although the ratio of variation is entirely different. Further experimentation will demonstrate that changes in the ratio of variation have no effect whatever upon the correlation coefficients.

To sum up, therefore, it seems:

1. That it would be wiser for economists to go more slowly in applying coefficients of correlation to historical economic variables, and that such coefficients should be used mainly as an aid in measuring the length of a lag.

2. That no coefficient equals the graphic method for demonstrating whether correlation does or does not exist.

3. That more work needs to be done in devising statistical methods of eliminating all but one cause before comparing that particular cause with its supposed effect.

4. That the ratio of variation should never be confused with a coefficient of correlation.

THE CORRELATION BETWEEN A COMPONENT, AND BETWEEN THE SUM OF TWO OR MORE COMPONENTS, AND THE SUM OF THE REMAINING COMPONENTS OF A VARIABLE.

By J. Arthur Harris, *Carnegie Institution of Washington, Station for Experimental Evolution, Cold Spring Harbor, N. Y.*

Many quantitatively measured variables with which the statistician has to deal in both social and biological sciences are really composite in character. Thus the death rates of a series of districts are made up of mortalities due to a number of causes. The total milk production of a cow is the sum of the productions of individual lactation periods which may differ greatly in quantity. The total length of an organism is the sum of the lengths of its component parts. The annual egg production of a fowl in an egg laying competition is the sum of the records for individual months.

Thus $x_1, x_2, x_3 \ . \ . \ . \ x_n$ are the components of the variable X, where $X = \Sigma(x)$.

It is customary, and in many instances quite proper, to deal with all such constituent elements as quite independent variables. When only one correlation involving two individual components is to be determined, a table may be formed in the usual manner. Cases may, however, arise in statistical analysis in which it is desirable to determine the correlation between the magnitude of any individual constituent element, x, of the variable X and the sum of the remaining elements $(X-x)$. Indeed, all possible measures of this kind may be needed, *i. e.*, $r_{x_1(X-x_1)}, r_{x_2(X-x_2)}, r_{x_3(X-x_3)}, \ . \ . \ . \ r_{x_n(X-x_n)}$.

If X be large and the values of $x_1, x_2, x_3 \ . \ . \ . \ x_n$ variable, the arithmetical routine may be troublesome, in fact practically prohibitive.

The correlation between the sum of two components and the sum of the remaining components

$$r_{(x_1+x_2)(X-x_1-x_2)},\ r_{(x_1+x_3)(X-x_1-x_3)}\ \ .\ .\ .\ \ r_{(x_1+x_n)(X-x_1-x_n)},$$
$$.\ .\ .\ \ r_{(x_2+x_3)(X-x_2-x_3)},\ \ .\ .\ .\ \ r_{(x_{n-1}+x_n)(X-x_{n-1}-x_n)},$$

or between the sum of three or more components and the sum of the remaining components, *e. g.*,

$$r_{(x_1+x_2+x_3)(X-x_1-x_2-x_3)},\ r_{(x_2+x_3+x_4)(X-x_2-x_3-x_4)},\ .\ .\ .$$
$$r_{(x_{n-2}+x_{n-1}+x_n)(X-x_{n-2}-x_{n-1}-x_n)},$$

or any of the other possible permutations which increase rapidly with the number of components, may be quite as important, at least, as the correlation between any individual component and the sum of the remaining components.

The determination of all such relationships is relatively simple providing the correlations between the components are known or their product moments have been determined.

Since these methods may not suggest themselves to those not familiar with the many possible modifications of the correlation formulae it seems worth while to put the equations on record.

The first requisite is the means and standard deviations of the sum of two or more components and of the difference between the variable and the sum of two or more components. The principle is well known.*

The value of σ_X is known and constant throughout. The variable values of σ_{x_1}, σ_{x_2}, σ_{x_3} . . . σ_{x_n} and r_{x_1X}, r_{x_2X}, r_{x_3X} . . . r_{x_nX} have also been determined. The standard deviation for the variable less any component, say the pth, is

$$\sigma^2_{(X-x_p)} = \sigma^2_X + \sigma^2_{x_p} - 2r_{x_pX}\sigma_X\sigma_{x_p}$$

For the sum of any number of components the standard deviation is given by

$$\sigma^2 = \sigma_{x_1}{}^2 + \sigma_{x_2}{}^2 + \ .\ .\ .\ + \sigma_{x_n}{}^2 + 2r_{x_1x_2}\sigma_{x_1}\sigma_{x_2} + 2r_{x_1x_3}\sigma_{x_1}\sigma_{x_3}$$
$$+\ .\ .\ .\ 2r_{x_2x_3}\sigma_{x_2}\sigma_{x_3} + \ .\ .\ .$$

In actual practise it is often most convenient to work from the original summations.† Thus the moments $\Sigma(x_1)$, $\Sigma(x_1^2)$,

* See for example, R. Pearl, Biometrika, Vol. VI, pp. 437–438, 1909, and G. U. Yule, Introduction to the Theory of Statistics, p. 208, 1911.

† Harris, J. Arthur. The arithmetic of the product moment method of calculating the coefficient of correlation. *American Naturalist*, Vol. XLIV, pp. 693–699, 1910.

$\Sigma(x_2)$, $\Sigma(x_2^2)$, $\Sigma(x_3)$, $\Sigma(x_3^2)$ . . . $\Sigma(x_n)$, $\Sigma(x_n^2)$ and $\Sigma(X)$, $\Sigma(X^2)$ with the product moments $\Sigma(x_1X)$, $\Sigma(x_2X)$, $\Sigma(x_3X)$ . . . $\Sigma(x_nX)$ lead directly to the desired results.

In the following section I give the equations in terms of the original moments or moment coefficients.

The means and standard deviations for the individual components, say for example the pth component, are

$$\bar{x}_p = \Sigma(x_p)/N, \quad \sigma^2_{x_p} = \Sigma(x_p^2)/N - [\Sigma(x_p)/N]^2$$

The means of the sums of the remaining components are quite obviously

$$\overline{(X - x_1)} = [\Sigma(X) - \Sigma(x_1)]/N, \text{ etc.},$$

while the standard deviations are given by

$$\sigma^2_{(X-x_1)} = \left\{\Sigma(X^2) - 2\Sigma(x_1X) + \Sigma(x_1^2)\right\}/N - \overline{(X - x_1)}^2,$$

$$\sigma^2_{(X-x_2)} = \left\{\Sigma(X^2) - 2\Sigma(x_2X) + \Sigma(x_2^2)\right\}/N - \overline{(X - x_2)}^2, \text{ etc.}$$

The mean for the sum of two components is

$$\overline{(x_p + x_q)} = [\Sigma(x_p) + \Sigma(x_q)]/N,$$

and so on for any number of components.

For the sum of the remaining $(n-2)$, $(n-3)$ components the means are

$$\overline{(X - x_p - x_q)} = [\Sigma(X) - \Sigma(x_p) - \Sigma(x_q)]/N,$$

and similarly for reductions due to the removal of 3, 4 or more components.

For the sum of two components, $(x_p + x_q)$

$$\sigma^2 = [\Sigma(x_p^2) + 2\Sigma(x_px_q) + \Sigma(x_q^2)]/N - \overline{(x_p + x_q)}^2$$

For three components, $(x_m + x_p + x_q)$

$$\sigma^2 = [\Sigma(x_m^2) + \Sigma(x_p^2) + \Sigma(x_q^2) + 2\Sigma(x_mx_p) + 2\Sigma(x_mx_q) + 2\Sigma(x_px_q)]/N - \overline{(x_m + x_p + x_q)}^2$$

For four components, $(x_h + x_m + x_p + x_q)$

$$\sigma^2 = [\Sigma(x_h^2) + \ . \ . \ . \ + \Sigma(x_q^2) + 2\Sigma(x_hx_m) + \ . \ . \ . \ + 2\Sigma(x_px_q)]/N - \overline{(x_h + \ . \ . \ . \ + x_q)}^2,$$

and so on for higher numbers of components.

The values of the means of the $(n-2)$, $(n-3)$, $(n-4)$ remaining components have been indicated.

The standard deviation of the value which remains after deducting the values of two components x_p and x_q is

$$\sigma^2=[\Sigma(X^2)+\Sigma(x_p^2)+\Sigma(x_q^2)-2\Sigma(x_pX)-2\Sigma(x_qX)+2\Sigma(x_px_q)]/N \\ -(\overline{X-x_p-x_q})^2$$

The value of $\sigma_{(X-x_m-x_p-x_q)}$ is given by

$$\sigma^2=[\Sigma(X^2)+\Sigma(x_m^2)+\Sigma(x_p^2)+\Sigma(x_q^2)-2\Sigma(x_mX)- \\ 2\Sigma(x_pX)-2\Sigma(x_qX)+2\Sigma(x_mx_p)+2\Sigma(x_mx_q)+ \\ 2\Sigma(x_px_q)]/N-(\overline{X-x_m-x_p-x_q})^2$$

The process for the value remaining after the renewal of four components is

$$\sigma^2=[\Sigma(X^2)+\Sigma(x_h^2)+\ .\ .\ .\ +\Sigma(x_q^2)-2\Sigma(x_hX)- \\ .\ .\ .\ -2\Sigma(x_qX)+2\Sigma(x_hx_m)+\ .\ .\ . \\ +2\Sigma(x_px_q)]/N-(\overline{X-x_h-\ .\ .\ .\ -x_q})^2$$

I now turn to the correlations.

Consider first of all the simplest of the two problems, the determination of the correlation between a component and the sum of the remaining components of the variable.

The correlations between the variable and its constituent elements r_{x_1X}, r_{x_2X}, r_{x_3X}, . . . r_{x_nX} are often wanted for themselves, and in any instance are relatively easily determined. The regressions of X on its constituent elements, say on the pth component, is

$$r_{x_pX}\frac{\sigma_X}{\sigma_{x_p}}$$

Obviously the regression slope of $(X-x_p)$ on x_p is

$$r_{x_p(X-x_p)}\frac{\sigma_{(X-x_p)}}{\sigma_{x_p}}=r_{x_pX}\frac{\sigma_X}{\sigma_{x_p}}-1,$$

or in terms of correlation

$$r_{x_p(X-x_p)}=r_{x_pX}\frac{\sigma_X}{\sigma_{(X-x_p)}}-\frac{\sigma_{x_p}}{\sigma_{(X-x_p)}}$$

I now turn to the formulae necessary for the determination of the correlation between the sum of any two components, say x_p and x_q, and the sum of the remaining components,

$(X-x_p-x_q)$, of any three components, say x_m, x_p and x_q, and the sum of the remaining components $(X-x_m-x_p-x_q)$, and between the sum of any four components, say x_h, x_m, x_p and x_q and the sum of the remaining components, $(X-x_h-x_m-x_p-x_q)$.

The product moments for the sum of two variables (x_p+x_q) and the sum of the remaining components $(X-x_p-x_q)$ is

$$\Sigma(x_pX)+\Sigma(x_qX)-2\Sigma(x_px_q)-\Sigma(x_p^2)-\Sigma(x_q^2)$$

For the sum of three components, $(x_m+x_p+x_q)$, and the sum of the remaining components, $(X-x_m-x_p-x_q)$, the product moment is

$$\Sigma(x_mX)+\Sigma(x_pX)+\Sigma(x_qX)-2\Sigma(x_mx_p)-2\Sigma(x_mx_q)-2\Sigma(x_px_q)$$
$$-\Sigma(x_m^2)-\Sigma(x_p^2)-\Sigma(x_q^2)$$

The product moment for four components $(x_h+x_m+x_p+x_q)$ and the sum of the remaining components is of course

$$\Sigma[(x_h+x_m+x_p+x_q)(X-x_h-x_m-x_p-x_q)]$$

which is easily thrown into the convenient form illustrated above for two and three components.

In certain cases the coefficient of correlation between a single component, say x_p, and the sum of the components remaining after the deduction of the pth and one or more other components is desired. Or, more generally, the coefficient of correlation between the sum of n components and the sum of the components remaining after the deduction of $n+1$, $n+2$, $n+3$ . . . components may be required.

The moments from which the means and standard deviations of the various components, sums of components and differences may be computed, have already been indicated. Thus the product moments only are required.

For the correlation between a single component, x_p, and the variable less two components, x_p and x_q, the product moment is

$$\Sigma(x_pX)-\Sigma(x_p^2)-\Sigma(x_px_q)$$

For the correlation between a component, x_p, and the variable less three components, $(X-x_p-x_q-x_m)$, the product moment is

$$\Sigma(x_pX)-\Sigma(x_p^2)-\Sigma(x_px_q)-\Sigma(x_px_m)$$

The formula for the product moment underlying the correlation between a component and the variable less the sum of a larger number of components is obvious.

For the sum of two components, (x_p+x_q), and the value of the variable less three components, $(X-x_p-x_q-x_m)$, the product moment is

$$\Sigma(x_pX)+\Sigma(x_qX)-\Sigma(x_p^2)-\Sigma(x_q^2)-2\Sigma(x_px_q)$$
$$-\Sigma(x_px_m)-\Sigma(x_qx_m)$$

Correlations beyond these for the sum of three components, $(x_p+x_q+x_m)$, and the value of the variable less that of four components, $(X-x_p-x_q-x_m-x_h)$, will be required very rarely indeed. The product moment for such a relationship is

$$\Sigma(x_pX)+\Sigma(x_qX)+\Sigma(x_mX)-\Sigma(x_p^2)-\Sigma(x_q^2)-\Sigma(x_m^2)-2\Sigma(x_px_q)$$
$$-2\Sigma(x_px_m)-2\Sigma(x_qx_m)-\Sigma(x_px_h)-\Sigma(x_qx_h)-\Sigma(x_mx_h)$$

Thus the formulae for the determination of all of the fundamental constants required in the calculation of the coefficient of correlation between the sum of from two to four components and the sum of the remaining components have been deduced.

Some of these results are known, others are such as anyone familiar with elementary statistical theory might write for himself. My object here has not been to express the relationships in the most elegant form but in that most convenient for practical work. The computer will note the great advantages of determining the moments and product moments for the individual components once for all. It is often just such simplification of method that greatly decreases the labor involved in the routine of the computing room.

PERSISTENCY OF DEPENDENCY—A STUDY IN SOCIAL CAUSATION.

By Maurice B. Hexter, *Superintendent, United Jewish Charities, Cincinnati, Ohio.*

Partaking of the generally prevalent attempts of sociologists at "objectivity," social workers have of late years turned their attention to the scientific measurement of social phenomena. Such descriptions of processes and functions were desired as might be verified and checked up by any investigator provided that he approached his task in a scientific spirit. It was recognized that by such winnowing of facts the truth might be found. This assumes a recognition of the necessity of eliminating the personal equation—"subjectivity." "This 'impersonal' view, has indeed, alone made science possible, and until recently has been considered the adequate and secure foundation of scientific method in all fields." It is only lately that we have begun to realize the true significance of scientific methods in the sphere of philanthropy. Keeping of strict records and efficient investigation of cases has been urged only from the standpoint of protection of charitable institutions from the impositions of unworthy applicants; such functions have been utilized for the better exposition of the scope and efficiency of the given agency. Such data, of late, however, have been considered invaluable material for scientific investigation and precise presentation.

The present investigation comprises a statistical analysis of the case records of the United Jewish Charities of Cincinnati. An analysis of the duration of dependency presumes a centralized agency, for then each case is carried until solution; it is not transferred for treatment to another or allied organization. Thus, the organization comprises all the functions for rehabilitation work. This all-inclusive coördination and correlation makes it possible precisely to denote exact duration of dependency. Transients have not been considered within the scope of this investigation since there is no reliable information in one single organization relative to the duration of a tran-

TABLE I.

NUMBER OF CASES AND RATES OF SOLUTION.

Year Case Opened.	Year of Exposure. 0. Number of Cases.	0. Solved.	0. Rate.	1. Number of Cases.	1. Solved.	1. Rate.	2. Number of Cases.	2. Solved.	2. Rate.	3. Number of Cases.	3. Solved.	3. Rate.	4. Number of Cases.	4. Solved.	4. Rate.	5. Number of Cases.	5. Solved.	5. Rate.	6. Number of Cases.	6. Solved.	6. Rate.	7. Number of Cases.	7. Solved.	7. Rate.	8. Number of Cases.	8. Solved.	8. Rate.	9. Number of Cases.	9. Solved.	9. Rate.	10. Number of Cases.	10. Solved.	10. Rate.	11. Number of Cases.	11. Solved.	11. Rate.	12. Number of Cases.	12. Solved.	12. Rate.	13. Number of Cases.	13. Solved.	13. Rate.	14. Number of Cases.	14. Solved.	14. Rate.	15. Number of Cases.	15. Solved.	15. Rate.	16. Number of Cases.	16. Solved.	16. Rate.	17. Number of Cases.	17. Solved.	17. Rate.	Existing at Close.
1897–1898	144	63	43.7	81	15	18.5	66	12	18.1	54	10	18.5	44	6	13.6	38	7	18.4	31	2	6.4	29	6	20.6	23	2	7.4	21	4	19.5	17	2	11.7	15	1	6.7	14	1	7.1	13	2	15.4	11	2	18.2	9	1	11.1	8	2	25.0	6	2	33.3	4
1898–1899	98	53	53.9	45	5	11.1	40	4	10.0	36	6	16.7	30	5	16.7	25	1	4.0	24	2	8.3	22	4	18.2	18	2	11.1	16	3	18.8	13	1	7.7	12	2	16.6	10	1	10.0	9	2	22.2	8	2	25.0	6	1	16.6	5	1	20.0	5	3	60.0				2
1899–1900	74	34	46.0	40	12	30.0	28	4	14.3	24	3	12.5	21	2	9.5	19	4	21.1	15	1	6.7	14	2	14.3	12	1	8.3	11	1	9.9	10	1	10.0	9	1	11.1	8	2	25.0	6	1	16.6	5	1	20.0	4	1	25.0							3
1900–1901	76	39	51.4	37	5	13.5	32	3	9.4	29	3	10.3	26	4	15.4	22	7	31.8	15	3	20.0	12	1	8.3	11	2	18.2	9	2	22.2	7	1	14.3	6	1	16.6	5	1	20.0	4	1	25.0	3	1	33.3										2
1901–1902	89	42	47.2	47	6	12.8	41	10	24.4	31	5	16.1	26	5	19.2	21	2	9.5	19	3	15.8	16	3	18.7	13	3	23.1	10	1	10.0	9	1	11.1	8	3	37.5	5	1	20.0	1	1	25.0													3
1902–1903	165	81	49.0	84	35	41.7	49	9	16.3	40	13	32.5	27	2	7.8	25	2	8.0	23	2	8.7	21	2	9.5	19	1	5.3	18	2	11.7	16	3	18.7	13	2	16.6	10	4	40.0																	6
1903–1904	158	58	36.8	100	23	23.0	77	17	22.1	60	9	15.0	51	7	13.6	44	6	13.6	38	4	10.5	34	2	5.9	32	3	9.4	29	6	20.7	23	11	47.8	12	2	16.6																			10
1904–1905	219	90	41.2	129	45	34.9	84	25	30.0	59	12	22.2	47	11	23.4	36	4	11.1	32	4	12.5	28	2	7.4	26	2	7.7	24	7	29.2	17	5	29.4																					12
1905–1906	154	67	43.5	87	23	26.4	64	20	31.3	44	9	20.5	35	6	17.1	29	1	4.2	28	3	10.7	25	6	24.0	19	6	31.6	13	5	38.5																									8
1906–1907	180	77	42.8	103	22	21.4	81	20	24.7	61	6	9.8	55	8	14.5	47	8	17.1	39	9	23.1	30	8	26.6	22	8	36.4																											14
1907–1908	311	153	49.2	158	51	32.3	107	21	19.7	86	13	15.1	73	8	10.9	65	14	21.5	51	8	15.7	43	14	32.6																															29
1908–1909	171	89	52.2	82	20	24.4	62	6	9.7	56	7	12.5	49	6	12.2	43	10	23.1	33	11	33.3																																			22
1909–1910	180	40	50.0	40	12	30.0	28	2	7.1	26	7	26.9	19	7	36.9	12	1	8.3																																							11
1910–1911	139	66	40.3	73	18	24.7	55	8	14.5	47	11	23.4	36	12	33.3																																									24
1911–1912	89	42	47.2	47	19	40.4	28	9	32.1	19	3	15.8																																												16
1912–1913	139	66	40.3	73	30	41.1	43	16	35.0																																															27
1913–1914	180	114	63.3	66	44	66.7																																																		22
Total	2,466			1,292			885			672			539			426			348			274			195			151			112			75			52			36			26			19			13			6			215
Solved	1,174			385			186			117			89			67			52			50			30			31			25			13			10			7			5			3			5			2			
Rate	47.8			30.0			21.0			17.4			16.5			15.7			15.0			18.2			15.4			20.5			22.3			17.3			19.3			19.4			19.2			15.8			38.4			33.3			

sient's dependency. Similarly, cognizance has only been taken of those cases wherein results were positively ascertainable.

The investigation was undertaken for three general purposes.

1. Is the duration of dependency increasing or decreasing?

2. Are relief agencies tending to pauperize their constituency, understanding by that term a "subjective condition in which a person prefers and persists in living on charity, loses his respect for self-dependence and has no ambition to obtain through his own efforts, a more comfortable life?" In other words, does the relief office tend to engender a feeling of what Marx terms "*verdammte Bedürfnisslosigkeit*"?

3. Assuming that duration of dependency is one of the many indices or coefficients of efficiency in relief work, is there a possibility of developing a measuring scale whereby the work of various cognate organizations may properly be compared?

From a certain point of view, duration of dependency may be considered as withdrawals from a life insurance corporation and statistically treated similarly.* The following table, then, is homologous to a table of withdrawals in life insurance and the annual withdrawal rates are therefore analogous to the rate of solution of a case of dependency or in other words the rate of duration.

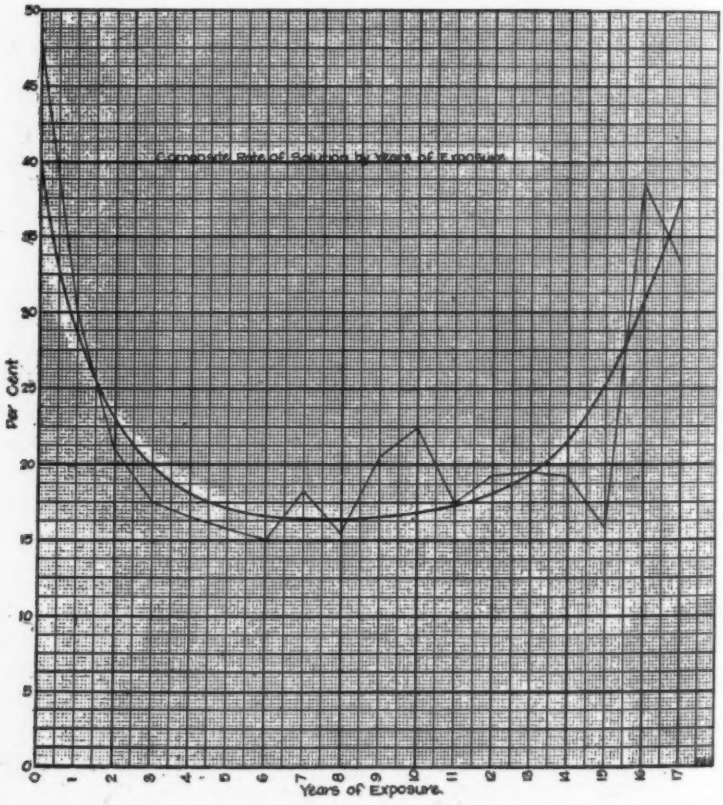
A word of explanation will make clear the meaning of the above table. Of 2,466 cases, 1,174 were solved with a duration of less than one year. The rate of solution, then, is 47.8 per hundred cases. Further, of 1,292 cases exposed to risk for a period of one year 385 were solved with a duration of one year. The rate, therefore, is 30 per hundred cases.

The light curve in the following chart is constructed from the actual rates of solution as given in Table III. The heavy is the smoothed curve through our rough data.† It can be seen that the rate of solution decreases rapidly for the first few years and then remains essentially the same for the fifth, sixth, seventh, eighth, ninth, tenth, eleventh, and twelfth years of duration. Thereafter the rise is rapid to the close of the seventeenth year of exposure. This may be ex-

* For a fuller explanation of the method herein used see Elderton and Pippard, Construction of Mortality and Sickness Tables, p. 29.

† For fuller explanation of the method see A. L. Bowley, Elements of Statistics, pp. 251–256.

plained by *a posteriori* reasoning somewhat as follows. The high rates of solution noticeable in the early years of exposure are due to the more or less acute cases of dependency. The medium rates of solution in the center of the mass of the data are due in large part to the chronic nature of the dependency, such as widowhood. The children are still small and no solution can be expected before the twelfth year of duration until two or three of the children have started to work. Color is lent to this hypothesis by the high rates of solution from the thirteenth year onward. Detailed examination of the cases for several years bears out directly this reasoning.



In addition to visualizing the rates of solution for our data, the curve may be used for comparative purposes. Thus, we

can determine whether any one single year gave a higher or a lower rate of solution than our average or composite. In this manner, we will be enabled to ascertain whether the duration of our dependency is increasing or decreasing. (To preclude unbiased errors we use the curve of actual average rather than the smoothed curve.) The following table shows the positive and negative deviations from the composite average. No account is taken of quantitative deviations but merely whether the deviation is positive or negative.

TABLE II.
POSITIVE AND NEGATIVE DEVIATIONS FROM THE COMPOSITE.

Year Case Opened.	Year of Exposure.																	Total Negative Deviations.	Total Positive Deviations.	Coincidences.	Total.
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.				
1897–1898	−	−	−	+	−	+	−	+	−	−	−	−	−	−	−	−	−	0	14	3	1	18
1898–1899	+	−	−	−	+	−	−	0	−	−	−	−	−	+	−	+	+		11	5	1	17
1899–1900	−	0	−	−	−	+	−	−	−	−	−	−	+	−	+	+			11	4	1	16
1900–1901	+	−	−	−	+	+	−	+	+	−	−	−	+	+	+				7	8		15
1901–1902	−	−	+	−	+	−	+	+	+	−	−	+	+	+					6	8		14
1902–1903	+	+	−	+	−	−	−	−	−	−	−	+	+						8	5		13
1903–1904	−	−	+	−	−	−	−	−	−	+	+	−							9	3		12
1904–1905	−	+	+	+	+	−	−	−	−	+	+								5	6		11
1905–1906	−	−	+	+	+	−	−	+	+	+									4	6		10
1906–1907	−	−	+	−	−	+	+	+	+										4	5		9
1907–1908	+	+	−	−	−	+	+	+											3	5		8
1908–1909	+	−	−	−	−	+	+												4	3		7
1909–1910	+	0	−	+	+	−													2	3	1	6
1910–1911	−	−	−	+	+														3	2		5
1911–1912	−	+	+	−															2	2		4
1912–1913	−	+	+																1	2		3
1913–1914	+	+																	0	2		2
Total																			94	72	4	170

In order to make clearer the data in the above table the deviations have been grouped into two parts: the first group comprises the series of years 1897–1898 through 1904–1905; the second group consists of the years 1905–1906 through 1912–1913. The following table shows this in concise form. From the table below it is noticeable that the proportion of negative deviations from our composite average decreases

Year.	Negative Deviations.		Positive Deviations.		Coincidences.	Total.
	Number.	Per Cent.	Number.	Per Cent.		
1897–1898 to 1904–1905	71	61.2	42	36.2	3	116
1905–1906 to 1912–1913	23	35.9	40	62.5	1	64

about 42 per cent. from the first period until the second period. In other words our rate of solutions of cases of various terms of exposure has materially increased in later years as is seen by the fact that of 116 observation periods 71, or 61.2 per cent., deviated negatively from our composite average, whereas in the second group there were 64 observation periods of which 23, or 35.9 per cent., deviated in a similar direction from our composite.

In all of the previous proofs of the decrease in duration of dependency we have formulated our comparison upon a composite average of all observations for all years and for varying terms of exposure. There remains another method of comparison, namely, to take as our basis the rates of solution of those cases arising during the year 1897–1898. In order to show the method involved the following table is shown. The structure of the table is such that we may ascertain what proportion of the cases originating in any one year have been solved after a definite term of exposure to solution. Thus, of the cases arising in the year 1900–1901, 71.3 per cent. have been solved after the fourth year of exposure, etc.

In order to simplify the table below we will tabulate the positive and negative deviations in a manner similar to the previous table where we tabulated the deviations from our

TABLE III.

CUMULATIVE RATES OF SOLUTION BY YEAR OF EXPOSURE.

Year Case Opened.	Year of Exposure.																
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1897–1898	43.7	54.1	62.4	69.4	73.6	78.6	80.0	84.2	85.6	88.4	89.8	90.5	91.2	92.6	94.0	94.7	96.1	97.4
1898–1899	53.9	59.0	63.1	69.2	74.3	75.3	77.3	81.4	83.4	86.5	87.5	89.5	90.5	92.5	93.5	94.5	97.5	
1899–1900	46.0	62.2	67.6	71.7	74.4	79.8	81.1	83.8	85.1	86.4	87.7	89.0	91.7	93.0	94.3	95.6		
1900–1901	51.4	58.0	62.0	66.0	71.3	80.5	84.5	85.8	88.0	90.6	91.9	93.2	94.5	95.8	97.1			
1901–1902	47.2	53.9	75.1	70.7	76.3	78.5	81.8	85.3	88.6	89.7	90.8	94.1	95.2	96.3				
1902–1903	49.0	70.2	75.7	83.7	84.9	86.1	87.3	88.5	89.1	90.3	92.2	94.1	96.0					
1903–1904	36.8	51.4	62.2	67.9	72.3	76.1	78.7	80.0	81.9	85.7	92.7	94.0						
1904–1905	41.2	61.7	73.1	78.6	83.6	85.5	87.4	88.3	89.2	92.4	94.7							
1905–1906	43.5	58.1	63.8	67.6	68.2	70.1	73.9	77.7	81.9	85.2								
1906–1907	42.8	55.0	66.1	69.5	73.8	78.2	83.2	87.6	92.0									
1907–1908	49.2	65.6	72.6	76.7	79.0	83.5	85.8	90.3										
1908–1909	52.2	63.9	67.4	71.5	75.0	80.9	87.3											
1909–1910	50.0	65.0	67.5	76.2	84.9	86.1												
1910–1911	40.3	53.3	59.1	66.6	75.2													
1911–1912	47.2	68.6	78.7	82.1														
1912–1913	40.3	61.9	73.4															
1913–1914	63.3	87.7																

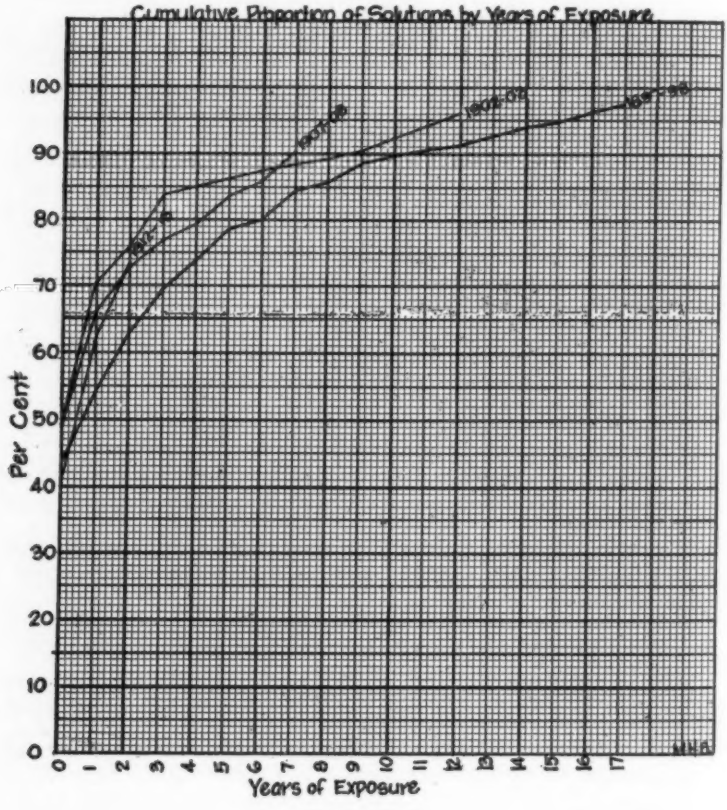
compositive average. The following table shows the results of such a tabulation.

TABLE IV.
POSITIVE AND NEGATIVE DEVIATIONS FROM BASIC YEAR.

Year Case Opened.	Year of Exposure.																Positive Deviations.	Negative Deviations.	Total.
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	
1898–1899	+	+	+	−	+	−	−	−	−	−	−	−	−	−	−	−	+		5	12	17
1899–1900	+	+	+	+	+	+	+	−	−	−	−	−	+	+	+	+			11	5	16
1900–1901	+	+	−	−	−	+	+	+	+	+	+	+	+	+	+				12	3	15
1901–1902	+	−	+	+	+	−	+	+	+	+	+	+	+	+					12	2	14
1902–1903	+	+	+	+	+	+	+	+	+	+	+	+	+						13	0	13
1903–1904	−	−	−	−	−	−	−	−	−	+	+	+							2	10	12
1904–1905	−	+	+	+	+	+	+	+	+	+	+								10	1	11
1905–1906	−	+	+	−	−	−	−	−	−	−									2	8	10
1906–1907	−	+	+	+	+	−	+	+	+										7	2	9
1907–1908	+	+	+	+	+	+	+	+											8	0	8
1908–1909	+	+	+	+	+	+	+												7	0	7
1909–1910	+	+	+	+	+	+													6	0	6
1910–1911	−	−	−	−	+	+													1	4	5
1911–1912	+	+	+	+															4	0	4
1912–1913	−	+	+																3	1	3
1913–1914	+	+																	2	0	2
Total																			104	48	152
Per cent.																			68.4	31.6	100.0

From the above table it will be seen that of 152 observation periods 104 deviated positively from our basic year—1897–1898. The proportion is 68.4 per cent. In other words, more than two thirds of the cumulative rates of solution are higher in periods subsequent to our basic year. Moreover the data we have compared are homogeneous, that is, we have compared rates of solution for cases of similar periods of exposure. It is interesting to notice that of the 108 observation periods in the first half of our data (namely from 1898–1899 to 1906–1907) 67, or about 62 per cent., deviate positively from the basic year. A similar calculation for the latter half of our data shows that of 44 observation periods 37, or about 84 per cent., deviate in a positive direction from our basic year. In other words, the rate of solution materially increases in the latter half of our data over the first half, taking the first year as our basic year for comparative purposes. This corroborates the comparison of our data with our composite average as shown in Table III. We see, then, that in all periods subsequent to our basic year the positive deviations far exceed the negative deviations. To restate the results, the rates of solution are

accelerated in later years, or in other words the duration of dependency is decreasing.



Summary.

To conclude, let us restate the threefold purpose of this statistical investigation. The first problem was to determine whether the duration of dependency is increasing or decreasing. The second problem was to determine whether relief agencies were fostering and engendering a state of pauperism. Thirdly, is there a possibility of developing a measuring scale of efficiency.

The answer to the first of these questions is easily given by the statement that the duration of dependency undoubtedly is decreasing. To assign causes for this decrease is difficult.

We may, I think, assume that the nature of the dependency with which we deal at present is at least as deep-seated and as chronic as that experienced fifteen years previous. Indeed, signs are not wanting that our current dependency is of a more chronic nature than hitherto. It seems that there is but one cause that will account for the constantly decreasing duration of dependency, especially since this decrease continues during years of cyclical fluctuations of labor. The cause, in our opinion, is to be found in the efficient rehabilitation that has been carried forward. We have set in action agencies which secure and discover cases of illness in their early incipiency. Thereafter, efficient coördination takes care of every emergency. On the side of illness, a convalescent home ends the rehabilitation. On the side of maladjustment to economic conditions a wholesome policy of establishment in business ventures has been prosecuted.

The second question can also be answered in the statement that relief agencies are not pauperizing their constituents as can be seen from the smoothed curve the shape of which can only be interpreted by the statement that those cases of long duration are more particularly, if not solely, composed of cases of long time dependency such as widowhood.

The third question relating to the possibility of developing a measuring scale or a norm is exceedingly theoretical. The first table presented in this study gave the rates of solution of cases of varying duration classed according to the year of origin. If similar studies were made over wide areas and by different organizations it would be possible to develop a table similar to the American Experience Table of Mortality in life insurance statistics. When such a table shall have been completed we can measure how far either above or below the expected rate of solution for any particular year of exposure a definite organization has reached. The corollary necessarily is that various organizations could be more intelligently compared than at present. It may be objected that the method is faulty, inasmuch as a large accession of widows with small children would tend to lengthen the duration of dependency. The answer to this objection is that the efficiency of an organization is to be found in the number of widowhoods that have been prevented.

REVIEWS AND NOTES

MINUTES OF THE FIRST MEETING OF PHILADELPHIA STATISTICIANS.

At the suggestion of Edwin W. Kopf, Assistant Statistician of the Metropolitan Life Insurance Company, and Carroll W. Doten, Secretary of the American Statistical Association, Dr. Chas. Scott Miller issued a call for a meeting of representative statisticians in the city of Philadelphia, together with local members of the American Statistical Association, to consider the advisability of organizing some statistical body in this city. Therefore, twenty-one invitations were extended and fourteen persons were present. The meeting was held on October 16 in the office of the Director of the Department of Public Health and Charities. Dr. Krusen, the Director, presided at the meeting and after expressing the purpose in issuing such a call, the subject was thrown open for general discussion. It was the concensus of opinion—

1. That there should be some standardization of method and improvement in statistical technique;
2. That data should be interpreted for public consumption in more of a non-technical manner than has been adopted heretofore.

It was moved by Dr. Jackson and seconded by Mr. Linton that a statistical organization be formed. The motion was carried. It was then moved and seconded that we affiliate ourselves with the American Statistical Association and establish a local branch of this body.

Temporary officers were chosen in the persons of Dr. Wilmer Krusen as Temporary Chairman and Dr. Chas. Scott Miller as Temporary Secretary. Mr. John A. Vogleson moved that the Chairman be authorized to appoint a committee of five on organization. Dr. Lee Welling Squier amended this motion by adding the Chairman and Secretary as members of this committee on organization *ex-officio*. The following were then appointed by the Chairman: Dr. Robert Riegel, Chairman; Prof. L. P. Myer, Dr. Louise Stevens Bryant.

The functions of said committee were defined as follows:

1. To draft a constitution and by-laws;
2. To plan for additional membership;
3. To suggest the number and method of conducting meetings, both for this body and for public gatherings;
4. To stimulate interest in statistical endeavors along all lines of work.

It was suggested that members send the names of any persons who might be interested in statistics to the Secretary and that an invitation be extended to these persons to attend our next meeting.

On motion of Dr. Francis D. Patterson, which was properly seconded, the meeting adjourned to meet at the call of the chair.

The following persons were present:

Dr. John Price Jackson, Commissioner, Pennsylvania Department of Labor and Industry;

Dr. Robert Riegel Assistant Professor of Insurance and Statistics, University of Pennsylvania;

Mr. George Wood;

Mr. George M. Merkle, Statistician, Division of Housing and Sanitation;

Miss Alice Haldemann, Bureau of Municipal Research;

Mr. William Byer, Bureau of Municipal Research;

Prof. L. P. Myer, Department of Economics, Temple University;

Dr. Louise Stevens Bryant, Municipal Court;

Dr. Lee Welling Squier;

Mr. M. Albert Linton, Vice-President, The Provident Life and Trust Co.;

Dr. Francis D. Patterson, Chief, Division of Hygiene and Engineering, Pennsylvania Department of Labor and Industry;

Dr. Wilmer Krusen, Director, Department of Public Health and Charities;

Mr. John A. Vogleson, Chief, Bureau of Health;

Dr. Chas. Scott Miller, Chief, Division of Vital Statistics.

CHAS. SCOTT MILLER, M. D.,
Secretary.

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By William H. Guilfoy, M.D., and Edwin W. Kopf.
New York Medical Journal, October 6, 1917.

This committee* was appointed in 1916 to inquire into the chief aspects of and requisites for public and private vital statistics work in the next census year and to submit constructive recommendations on these points.

This report is more of a summary of recent progress in the general field of vital statistics and closely related social statistics of various kinds than a program for the Census of 1920. The committee apparently thinks of the U. S. Census for the year 1920 in two ways, namely, as a definite date for a general review and as an agency for accomplishing certain things.

A goal is always desirable as a spur to effort, and there is much to be said in favor of making 1920 the end of a period within which certain reforms should be accomplished. It should be borne in mind, however, that an inventory is not only a means of closing up the accounts of past transactions, but is a basis for new enterprise to follow, and its taking should not be made so important and absorbing as to distract attention from or to impede the regular ongoing of the business.

Naturally the committee lays much stress on vital statistics, but it does not neglect the opportunity to make helpful suggestions of improvements in the enumeration of population, by racial and local groups, which would be of service to social investigators as well as to those working for improved health and sanitation.

* William H. Guilfoy, chairman, Cressy L. Wilbur, Frederick L. Hoffman, Wade H. Frost, James W. Glover, Frans Schneider, Jr., John S. Fulton, William H. Davis, Walter F. Willcox, and Edwin W. Kopf, corresponding secretary.

Perhaps the most important thing to be done at the time of or through the Census of 1920 is to obtain more nearly adequate statistics of sickness than are now available. The movement for the institution of health insurance in the various states that have already started on a program of social insurance through the enactment of workmen's compensation laws would be greatly facilitated by such statistics, and all public health work would be afforded a fact basis which it now lacks to a large degree.

The committee is to be commended for its painstaking work and it is to be hoped that some part, at least, of its excellent program may be carried out in the next census.

C. W. Doten.

Massachusetts Institute of Technology.

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